State of Maryland

DEPARTMENT OF THE ENVIRONMENT

2500 Broening Highway, Baltimore, Maryland 21224

Area Code 301 • 631-

William Donald Schaefer
Governor

Martin W. Walsh, Jr.
Secretary

November 2, 1990

Ms. Ruth Hodgson
Maryland State Law Library
Courts of Appeal
361 Rowe Boulevard
Annapolis, MD 21401

Dear Ms. Hodgson:

Per your recent request for Indoor Air Quality Task Force meeting minutes that you are missing, I am enclosing the minutes from the May 11, 1990. The following is an accounting of the remaining meetings:

August and October - no meetings
December 21, 1989 - no minutes prepared
January 18, 1990*
February 18 & 26, 1990*
March 8, 16, 23 & 30, 1990*

***No minutes, preparation of final report to Governor**

If you have any question or need further information, please do not hesitate to call at (301)631-3855.

Sincerely,

Karen L. Underwood

Karen L. Underwood
Special Assistant
Toxics, Environmental
Science and Health

Enclosure

JLf

GOVERNOR'S TASK FORCE ON INDOOR AIR QUALITY

May 11, 1989 Meeting

M I N U T E S

ATTENDANCE

Members: Mr. Allen Abend
Dr. Alvin Bober
Del. Donald Elliott
Dr. Max Eisenberg
Dr. Katherine Farrell
Mr. Allan Heaver
Dr. Jefferson Herring
Dr. Thomas Hobbins
Sen. Barbara Hoffman
Mr. William Hubalek
Mr. Ronald LeClair
Mr. James Miller
Mr. Mark Wagner (representing
Mr. Henry Kramer, Member)
Mr. Arthur Wheeler

July 13th next meeting.

MDE Staff: Mr. Daniel LaHart
Ms. Karen Pushkar
Dr. Jeffrey Paull
Dr. Alice Zeiger

Dr. Katherine Farrell, Chair, convened the first meeting of the Governor's Indoor Air Quality Task Force at 1:45 p.m. She welcomed everyone and gave a brief history on the impetus of the Task Force. She also mentioned that Dr. Myron Miller, Director, Department of Legislative Reference's Research Division, was assigned to staff the Task Force, but he was unable to attend this first meeting.

Following the welcoming remarks, Dr. Farrell gave each member the opportunity to introduce himself and to identify his background and interest on the subject of indoor air quality.

Addressing the real purpose of the Task Force, Senator Barbara Hoffman emphasized that the two major tasks of the group were to determine the extent of the existence of indoor pollutants and to make recommendations to the Governor and General Assembly as to how to address the mitigation of these pollutants. She added that the Task Force charge is to look at the overall problem and not to single out various pollutants.

As evidence that the State is already active in attempting to address the indoor air pollution concern, Dr. Farrell handed out copies of two documents - the Governor's Radon Task Force Final Report and the Chemical Hypersensitivity Syndrome Study. She suggested that these reports would be good references for the members to be familiar with. As another appropriate reference source, Mr. Allen Abend, Department of Education, distributed copies of the Indoor Air Quality Maryland Public Schools document which addresses the planning, design, maintenance and operation of public schools.

With regard to public schools, Mr. Abend discussed the newly published reported entitled "Indoor Air Quality Management Program for Anne Arundel County Schools." He explained that the County had been awarded a grant from the Maryland Department of Education and the U.S. Environmental Protection Agency to develop a program to address indoor air quality problems that could be used as a model nationwide. He distributed copies of a document entitled Indoor Air Quality in Maryland Schools.

Due to his meeting with Governor Schaefer, Department of the Environment's Secretary Walsh arrived late to the meeting. He welcomed and thanked everyone for their willingness to serve on this important Task Force. He expressed his enthusiasm for working with the members and looking forward to receiving input from the group.

Since the Task Force was late in being set up, Secretary Walsh suggested various ways for the group to address the date of the final report submission; i.e., prepare a preliminary report or ask the Governor for an extension. Senator Hoffman added that if an extension is deemed necessary, then the request for an extension should be made early.

Dr. Farrell asked for reactions to her proposal to break the Task Force up into subcommittees and how to address the interested parties issue. With regard to the subcommittee division, Senator Hoffman suggested, and everyone agreed, that the first order of business should be to define problem, then divide into subcommittees. She also suggested that a public hearing be held to invite interested parties to come in and address the Task Force for a predetermined amount of time.

In an attempt to educate the public, Dr. Eisenberg, Center for Indoor Air Research, recommended that the Task Force disseminate information describing common sense approaches to addressing the indoor air quality problem.

Dr. Herring, Davison Chemical Division, recommended that a common database of major pieces of information on indoor air quality be brought to the attention of all task force members. With that recommendation, Task Force members will share their knowledge of publications at next month's meeting.

For the June meeting, the following suggestions were offered as possible agenda topics:

1. Kevin Teichman - EPA to discuss EPA's indoor air quality program;

2. Allen Abend - DOE to discuss what the schools are doing to address indoor air quality problems.

The next two meetings of the Task Force are scheduled for June 8 and July 13 from 3 p.m. to 5 p.m. and are to be held at the Department of the Environment's Headquarters Executive Conference Room at the second floor of 2500 Broening Highway in Baltimore.

The meeting adjourned at 3:40 p.m.

File: INAQTKMT.lj

GOVERNOR'S TASK FORCE ON INDOOR AIR QUALITY

June 8, 1989 Meeting

REVISED MINUTES

Attendance

Members: Allen Abend
Alvin Bober
Max Eisenberg
Don Elliott
Katherine Farrell
Tony Fulton
Allan Heaver
Jefferson Herring
Thomas Hobbins
Barbara Hoffman
William Hubalek
Henry Kramer
Ronald LeClair
James Miller
Arthur Wheeler

Other: Karl Aro
Simon Powell
Alice Zeiger
Gloria Peterson
Karen Pushkar
Kevin Teichman

Dr. Katherine Farrell, Chairman, called the meeting to order at 3:00 p.m. The minutes were approved after one amendment offered by Dr. Hobbins that they should reflect that tobacco smoke should be included as an indoor pollutant.

Public Hearing

A public hearing will be held in Annapolis on September 7 in the Joint Hearing Room of the Legislative Services Building. After discussion of various options, it was decided to schedule it for 5:00 p.m. to allow for more public participation and ease of parking.

Correspondence Received

Mr. Bober has written to Dr. Farrell (letter attached) concerning the building code from an indoor air quality standpoint.

<u>Presentation of Dr. Kevin Teichman - U.S. Environmental Protection Agency's Indoor Air Quality Research Program</u>

Mr. Teichman began his presentation by stating that the United States was not the only country grappling with the problem of indoor air quality. He identifies major indoor air pollutant as radon, asbestos, formaldehyde, combustion products, organic compounds, and biological aerosols. Of these radon and asbestos are the most important carcinogens. The culprits of sick building syndrome are formaldehyde, combustion products - include tobacco smoke, organic compounds, and biological aerosols identified as "sick building pollutants".

Major federal players in the indoor air quality field are:

E.P.A. (including the Office of Air and Radiation; the Office of Pesticides and Toxic Substances; and the Department of Energy

Consumer Product Safety Commission

Department of Health and Human Services (the National Institute for Occupational Safety and Health -- NIOSH)

Other important players in the indoor air quality field include:

Bonneville Power Administration (in the Pacific Northwest)
Tennessee Valley Authority (wood stoves)
General Services Administration (seniors for return air in buildings)
Department of Housing and Urban Development
National Institute of Standards and Technology

Mr. Teichman has also described EPA's monitoring and research program which has four major components - (1) monitoring, (2) engineering, (3) health effects, and (4) exposure,assessment and risk assessment/characterization. Highlights of program include the TEAM studies, monitoring and methods development, air quality modelling and sick building field studies (interagency). He made the point that a radon mitigation research is also applicable to pesticide mitigation in homes. He also described chamber studies to determine organic emissions from products, test house studies and studies of specific pollutants. The health effects research has already identified Cotinine as a biomarker for tobacco smoke. Research continues on neurobehavioral and sensory irritant effects of VOC environmental tobacco smoke on preschool children have demonstrated that respiratory infection rates are influenced by these pollutants. The Environmental Criteria and Assessment Office is evaluating different approaches to exposure assessment and risk characterization. They have prepared a detailed bibliography.

The Department of Energy has a role in indoor radon, indoor air quality control techniques, infiltration, ventilation, and indoor air quality and energy performance in buildings. Some innovative techniques discussed were directing air to where the people are located and the idea that energy efficiency and air quality are not incompatible.

Consumer Product Safety Commission is involved primarily with kerosene and gas space heaters. The Commission has done chamber and field studies of acid and biological aerosols. Recently, the Commission has become involved with ultrasonic humidifiers and studying the VOC emissions from consumers products. Three particular products are methylene chloride, hair sprays and perfumes.

Generally, the major federal concern has been radon research (with about $12-15 million funding); other indoor air pollutant efforts receiving $5-7 million in funding.

Current proposed federal legislation concerning indoor air quality centers on S.657 (Mitchell) and H.1530 (Kennedy--essentially a companion bill). S.657 can be summarized as follows:

No regulatory authority authorizes funding at $48.5 million per year for 5 years calls for expanded esmarch/demonstration
Involves health advisories, state grants ($20 million), and a National Response Plan
Intensifies the NIOSH "sick building" investigation program
Establishes an Information Clearinghouse (consumer "hotline")

However, S.657 has not received any administrative approval/endorsement to date. Senate committee scheduled to meet on June 14, 1989 and House hearings are scheduled for July.

A report to Congress on Indoor Air Quality prepared by EPA but lacking approval by the Office Management and budget has been released in draft form by Senator Lautenburg - D - New Jersey.

Mr. Teichman offered to come to another Task Force meeting to go into the research/monitoring program in greater detail. Also, Mr. Teichman suggested that the Task Force invite Bob Axelrad to come in and give a presentation on the policy side of EPA's Indoor Air Quality Program.

Presentation of Al Abend--Maryland Department of Education

Identified a number of reasons why indoor air quality is a problem in Maryland's schools:

Often a result of energy conservation programs.
The nature of the materials used - both in construction and furnishings.
Buildings have changed in function and occupancy without corresponding changes to the HVAC system which has impacted indoor air quality.
Maintenance is often a low budget priority for many school systems.
The training of school architects and builders often does not include training on indoor air quality.

The response to indoor air quality concerns in the State's schools has come with the publication of two manuals entitled "Indoor Air Quality - Maryland Public Schools" published by the Maryland Department of Education and "Indoor Air Quality Management Program" developed by the State Department of Education and Anne Arundel County.

Senator Hoffman asked how this management program was being implemented in Anne Arundel County. Mr. Abend responded that this program was for the schools' reference and use as appropriate.

She also asked how the indoor air quality problem will be handled throughout the State. Mr. Abend said that the indoor air manual was sent to all public school systems plus he has been meeting with the schools to discuss the manual. Also, Mr. Abend has held Statewide training sessions. Mr. Abend added that the schools are currently hiring staff to deal with environmental health issues.

The program is geared only at the public school system - a matter of policy. Dr. Tom Hobbins and Senator Hoffman raised the point that the private schools and the State Higher Education system needs information on indoor air quality management also. Senator Hoffman suggested that representatives from non-public schools and higher education be invited to any indoor air quality workshops that are sponsored by Department of Education.

The program calls for a common-sense approach to prevention of indoor air pollution, with an emphasis laid on raising awareness of the possible indoor air quality consequences of an action - for example, when roofing. Although the management program includes within it the use of building inspections - costly and long-term procedures - many other aspects of the program are relatively inexpensive to implement.

Major weakness of the management program is the lack of knowledge that is available on the potential hazards of certain building materials and furnishings. Further, what information is available is often ill suited to decision-making.

Mr. Abend mentioned that Montgomery County currently provides courses on integrated pest management in schools and has demonstrated that it is both environmentally and economically beneficial.

<u>Other Business</u>

Next meeting set for July 13, at the Department of the Environment, 2nd floor conference room at 3:00 to 5:00 p.m. The meeting will include a presentation by Arthur Wheeler on ASHRAE standards, evaluation of standards, and a systems approach to indoor air quality and Bob Axelrad from EPA to discuss the indoor air quality program policy issues.

The MDE Library (2nd floor, Department of the Environment) will devote a section to indoor air quality materials. This will include those materials considered too bulky for general distribution to the Task Force.

GOVERNOR'S TASK FORCE ON INDOOR AIR QUALITY

GOVERNOR'S TASK FORCE ON
INDOOR AIR QUALITY
June 8, 1989 Meeting

M I N U T E S

Attendance

Members:	Allen Abend Alvin Bober Max Eisenberg Don Elliott Katherine Farrell Tony Fulton Allan Heaver Jefferson Herring Thomas Hobbins Barbara Hoffman William Hubalek Henry Kramer Ronald LeClair James Miller
Other:	Karl Aro Simon Powell Alice Zeiger Gloria Peterson Karen Pushkar Kevin Teichman

Dr. Katherine Farrell, Chairman, called the meeting to order at 3:00 p.m. The minutes were approved after one amendment offered by Dr. Hobbins that they should reflect that tobacco smoke should be as an indoor pollutant.

Public Hearing

A public hearing will be held in Annapolis September 7 in the Joint Hearing Room. After discussion of various options, it was decided to schedule it for 5:00 p.m. to allow for more public participation and ease of parking.

Correspondence Received

Mr. Bober had written to Dr. Farrell (letter attached) concerning the building code from an indoor air quality standpoint.

<u>Presentation of Dr. Kevin Teichman - U.S. Environmental Protection Agency's Indoor Air Quality Research Program</u>

Mr. Teichman began his presentation by stating that the United States was not the only country grappling with the problem of indoor air quality. He identifies major indoor air pollutants as radon, asbestos, formaldehyde, combustion products, organic compounds, and biological aerosols. Of these radon and asbestos are the most important carcinogens. The culprits of sick building syndrome are formaldehyde, combustion products - include tobacco smoke, organic compounds, and biological aerosols identified as "sick building pollutants").

Major federal players in the indoor air quality field are:

E.P.A. (including the Office of Air and Radiation; the Office of Pesticides and Toxic Substances; and the Department of Energy

Consumer Product Safety Commission

Department of Health and Human Services (the National Institute for Occupational Safety and Health--NIOSH)

Other important players in the indoor air quality field include:

Bonneville Power Administration (in the Pacific Northwest)
Tennessee Valley Authority (wood stoves)
General Services Administration (seniors for return air in buildings)
Department of Housing and Urban Development
National Institute of Standards and Technology

Mr. Teichman has also described EPA's monitoring and research program which has four major components - (1) monitoring, (2) engineering, (3) health effects, and (4) exposure, assessment and risk assessment/characterization. Highlights of program include the TEAM studies, monitoring and methods development, air quality modelling and sick building field studies (interagency). He made the point that a radon mitigation research is also applicable to pesticide mitigation in homes. He also described chamber studies to determine organic emissions from products, test house studies and studies of specific pollutants. The health effects research has already identified Cotinine as a biomarker for tobacco smoke. Research continues on neurobehavioral and sensory irritant effects of VOC mixtures. The effects of indoor pollutants (NO2 and environmental tobacco smoke) on preschool children have demonstrated that respiratory infection rates are influenced by these pollutants. The Environmental Criteria and Assessment Office is evaluating different approaches to exposure assessment and risk characterization. They have prepared a detailed bibliography.

The Department of Energy has a role in indoor radon, indoor air quality control techniques, infiltration, ventilation, and indoor air quality and energy performance in buildings. Some innovative techniques discussed were directing air to where the people are located and the idea that energy efficiency and air quality are not incompatible.

Consumer Product Safety Commission is involved primarily with kerosene and gas space heaters. The Commission has done chamber and field studies of acid and biological aerosols. Recently, the Commission has become involved with ultrasonic humidifiers and studying the VOC emissions from consumers products. Three particular products are methylene chloride, hair sprays and perfumes.

Generally, the major federal concern has been radon research (with about $12-15 million funding); other indoor air pollutant efforts receiving $5-7 million in funding.

Current proposed federal legislation concerning indoor air quality centers on S.657 (Mitchell) and H.1530 (Kennedy--essentially a companion bill). S.657 can be summarized as follows:

No regulatory authority authorizes funding at $48.5 million per year for 5 years calls for expanded research/demonstrations
Involves health advisories, state grants ($20 million), and a National Response Plan
Intensifies the NIOSH "sick building" investigation program
Establishes an Information Clearinghouse (consumer "hot-line")

However, S.657 has not received any administrative approval/endorsement to date. Senate committee scheduled to meet on June 14, 1989 and House hearings are scheduled for July.

A report to Congress an Indoor Air Quality prepared by EPA but lacking approval by the Office Management and Budget has been released in draft form by Senator Lautenburg - D - New Jersey.

Mr. Teichman offered to come to another Task Force meeting to go into the research/monitoring program in greater detail. Also, Mr. Teichman suggested that the Task Force invite Bob Axelrad to come in and give a presentation on the policy side of EPA's Indoor Air Qualtiy Program.

Presentation of Al Abend--Maryland Department of Education

Identified a number of reasons why indoor air quality is a problem in Maryland's schools:

Often a result of energy conservation programs
The nature of the materials used - both in construction and fittings
Buildings have changed in function and occupancy which has impacted indoor air quality (for example, copy machines are now common in schools)
Maintenance is often a low priority for most school systems
The training of school architects and builders often does not include training on indoor air quality.

The response to indoor air quality concerns in the State's schools has come with the publication of a manual entitled "Indoor Air Quality Management Program" developed by the State Department of Education and Anne Arundel County.

Senator Hoffman asked how this management program was being implemented in Anne Arundel County. Mr. Abend responded that this program was for the schools' reference and use as appropriate.

She also asked how the indoor air quality problem will be handled throughout the State. Mr. Abend said that the indoor air manual was sent to all public school systems plus he has been meeting with the schools to discuss the manual. Also, Mr. Abend has left statewide training sessions. Mr. Abend added that the schools are currently hiring staff to deal with environmental health issues.

The program is geared only at the public school system - a matter of policy. Dr. Tom Hobbins and Senator Hoffman raised the point that the private schools and the State Higher Education system needs information on indoor air quality management also. Senator Hoffman suggested that representatives from non-public schools and higher education be invited to any indoor air quality workshops that are sponsored by Department of Education.

The program calls for a common-sense approach to prevention of indoor air pollution, with an emphasis laid on raising awareness of the possible indoor air quality consequences of an action - for example, when roofing. Although the management program includes within it the use of building inspections - costly and long-term procedures - many other aspects of the program are relative by inexpensive to implement.

Major weakness of the management program is the lack of knowledge that is available on the potential hazards of certain building materials and fittings. Further, what information is available is often ill suited to decision-making.

Mr. Abend mentioned that Montgomery County currently provides courses on integrated pest management in schools and has demonstrated that it is both environmentally and economically beneficial.

Other Business

Next meeting set for July 13, at the Department of the Environment, 2nd floor conference room at 3:00 to 5:00 p.m. The meeting will include a presentation by Arthur Wheeler on ASHRAE standards, evaluation of standards, and a systems approach to indoor air quality and Bob Axelrad from EPA to discuss the indoor air quality program policy issues.

The MDE Library (2nd floor, Department of the Environment) will devote a section to indoor air quality materials. This will include those materials considered too bulky for general distribution to the Task Force.

GOVERNOR'S TASK FORCE ON

INDOOR AIR QUALITY TASK FORCE

July 13, 1989

M I N U T E S

Attendance

Members:
Allen Abend
Alvin Bober
Max Eisenberg
Katherine Farrell
Allan Heaver
Thomas Hobbins
Barbara Hoffman
William Hubalek
Henry Kramer
Ronald LeClair
Arthur Wheeler

Others:
Robert Axelrad
James Lewis
Myron Miller
John McQuade
Gloria Peterson
Karen Pushkar
Chani Roser
Alice Zeiger

The meeting was convened at 3:00 p.m. by Katherine Farrell, Chairman. Corrections and additions to the June 8 minutes offered by Al Abend and Art Wheeler were noted and are reflected in the attached revision.

Two speakers had been invited for the purpose of reviewing the status of professional (American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), Building Officials and Code Administrators (BOCA)) and federal (primarily EPA) programs aimed at reducing indoor air pollution. Major policy, administrative and technical issues were covered by each of these presentations.

Presentation of Art Wheeler - ASHRAE Standards and Systems Approach to Indoor Air Quality

The Chair introduced Mr. Art Wheeler of Wheeler Engineering, who has been closely following ASHRAE & BOCA developments on indoor air quality.

Of the three factors controlling indoor air quality; namely, design, construction and management, the last mentioned presently offers the largest potential for improvement. Seven years of work have gone into formulating upcoming standards for residential buildings. Mr. Wheeler characterized the main thrusts of ASHRAE-62-1989 (pending release for review in September, 1989) as being:

i) Delineation of acceptable levels of indoor air pollutants, and

ii) Selection of the most appropriate ventilation rates.

This pair of criteria is usually only weakly linked to relationships between indoor and outdoor air pollution.

Prior to the "Energy Crisis", five cubic feet per minute (CFM) per occupant was the industry standard for ventilation. Desire for energy conservation led to questioning of whether a lesser air turnover rate might be adequate. The 1987 BOCA national mechanical code cites five CFM as a minimum ventilation rate. The minimum ventilation rate for ASHRAE-62-1989 would fulfill two criteria: a) no detectable air contaminants present and b) 80 percent of a building's occupants rate the building's air quality as being acceptable. Cigarette smoking drastically reduces a space's ability to satisfy either of these criteria so that two different standards are being proposed for smoking and non-smoking areas.

Building occupants' ratings of indoor air quality depend on such confounding variables as air temperature, humidity and work-related factors, making the subjective criterion hard to interpret in a quantitative way. From studies based on expressed occupant discomfort, it has been found that carbon dioxide in excess of 1000 ppm, carbon monoxide above 2 ppm, and volatile organic compounds at more than 1.0 to 1.25 micrograms per cubic meter, for example, are associated with unacceptable ratings.

The impact of proper ventilation on heating and cooling costs appear to be modest. Typically, refrigeration capacity must be increased by 5% (a capital cost), cooling energy expenditures rise by 2% to 3% and heating costs go up by 1.5% to 2%. Building age and instantaneous occupancy rates can strongly influence needed ventilation rates. Buildings' inside finishings and furnishings have outgasing rates that decrease exponentially with time. Therefore, outgasing and pollutant partial pressures are strongest when a building is new. Regulations in some European countries require new buildings to remain unoccupied until outgasing rates fall to acceptable levels.

Occupancy rates in buildings such as hospitals are fairly static, but in schools, malls and office buildings, occupancy fluctuates markedly from night to day or, sometimes, from hour to hour (eg. a high school auditorium). Ventilation controls designed to follow that part of a system's loading due to occupancy can, under the new ASHRAE recommendations, result in more than tenfold swings (and commensurate operating cost savings) in ventilation rates.

Senator Hoffman asked what was the next step in the processes of adopting and implementing new standards. Mr. Wheeler answered that various model code organizations will review the pending ASHRAE standards and will help to develop model legislation. He believes it is in Maryland's interest to await the maturation of such model legislation, as we have done traditionally, rather than trying to pioneer in this area. In addition to the formidable difficulty in assessing chronic and transient health effects of indoor air pollutants, there are sticky legal implications to be dealt with. The American Society of Mechanical Engineers (ASME), still smarting from being successfully sued for seven million dollars over inappropriate guidelines in the recent past, is now proceeding cautiously, taking time for lots of public hearings and appeals. Lawyers, boards of directors and standards committees are iteratively reviewing all guidelines.

<u>Presentation of Robert Axelrad - EPA's Indoor Air Quality Program - Policy Issues</u>

The Chair welcomed Mr. Robert Axelrad of EPA's Office of Atmospherics and Indoor Air Quality.

He portrayed the past and current level of commitment of the agency to the Indoor Air Division by noting that seven positions are currently devoted to indoor air policy while 27 slots are alloted to public information dissemination and liaison with academia, interest groups and sister agencies abroad. Substantial growth, at least in relative terms, appears to be in the offing: in the next budgetary cycle, the policy branch is slated to go from a budget of $350K to $1400K.

In reviewing the reasons for persistent and growing interest in indoor air quality, Mr. Axelrad noted that:

1) Indoor air pollution concentrations frequently exceed ambient (outdoor) levels by factors of 2 to 5, and even more markedly in new or renovated buildings;

2) Typically, 90% of peoples' time, and hence exposure, is spent indoors;

3) Improved instrumentation and measurement techniques and changes in building materials and furnishings have heightened concern over the acute and chronic effects of indoor air pollution, and

4) The media have been taking a keen interest in the topic, especially since the reports of gross problems within the EPA Headquarters building itself.

These ample reasons for public and private concern notwithstanding, governmental progress to date has been slow, mainly because of the daunting complexity of the problem. Not only is there a dearth of convincing clinical and epidemiological data on some of the widespread pollutants, but there is a layered multiplicity of:

i) Building types

ii) Pollution sources

iii) Species of pollutants

iv) Possible synergistic effects, and

v) Confounding factors such as temperature and other stresses.

While realizing that progress would be neither quick nor easy, Congress in 1988 appropriated two million dollars for EPA to gear up for dealing seriously with indoor air pollution.

Both Congress and EPA are aware of how easily legislation can "get ahead of" science, so that prescriptive regulation is not the immediate program goal. As of now, the main policy elements and goals of EPA's indoor air program are as follows:

a) Characterize the most pressing problems through research and analyses. A forthcoming report to Congress will outline tentative priorities. Also in preparation is a "Research Needs" document. One of the more immediate needs is to know if the pending ASHRAE criterion of 80% of a buildings occupants finding its air quality subjectively "acceptable" adequately protects human health.

b) Assess mitigation strategies. In order to gauge what kinds of manpower and expertise is available in the private sector, EPA is surveying private firms. To date, they have identified approximately 1200 pertinent businesses of which about 200 have broad capabilities in the mitigation of indoor air quality problems.

c) Implement mitigation strategies, preferably by non-regulatory means;

d) More effectively utilize those regulatory programs that do exist

e) More aggressively seek means to abate indoor tobacco smoking,

f) Continue to distribute public information. (A pamphlet, like one given to Task Force Members, has already been distributed to 240,000 people.) Also, target architects, builders, interior designers and purchasing agents with information on how to reduce indoor air pollution. (An apt example of this is the building management manual prepared for Maryland school districts.)

Noteworthy pending federal legislation is SB 657 and its companion bill HB 1530. Its provisions include:

1) No new regulatory authority;

2) $ 48 million per year;

3) Expanded research and demonstration programs;

4) State Grants;

5) Development of a National Response Plan;

6) Information clearinghouse, and

7) NIOSH building investigation program.

When asked about the niche for possible Maryland legislation in this area, Mr. Axelrad gave no specific recommendations, but did offer several observations:

i) "Maryland is already ahead of most states" with respect to addressing indoor air quality. In fact, EPA plans to generalize the Anne Arundel county school air management report and offer it nationwide to 44,000 school districts;

ii) New Jersey and California have laws, regulations and programs worth reviewing;

iii) Innovation in institutional arrangements is probably a fertile area for state work, but technical R&D is generally not an auspicious place for state expenditures;

iv) Another ripe area for state involvement would be in enhanced information dissemination, perhaps taking federal information and delivering it, with follow up outreach and tracking, on a grassroots level. The EPA contact person for cooperative information services is Ms Betsy Agle. She could be reached at (202) 382-7753.

The Chair postponed until the August 3 meeting the presentation of material on how houseplants can improve indoor air quality, and adjourned the meeting at 5:15 pm.

Respectfully submitted,

Myron Miller

MINUTES

GOVERNOR'S TASK FORCE ON INDOOR AIR QUALITY

September 21, 1989

Members in Attendance:	Others Present:
Allen Abend	James Lewis
Alvin Bober	John McQuade
Max Eisenberg	Myron Miller
Donald Elliott	Jeff Paull
Katherine Farrell	Karen Pushkar
Allan Heaver	Alice Zeiger
Jefferson Herring	
Thomas Hobbins	
Barbara Hoffman	
William Hubalek	
Ronald LeClair	
James Miller	

Chairman Farrell greeted the members and brought the meeting to order at 3:00 p.m. Minutes of the previous meeting were read and approved.

An educationally-oriented video on indoor air pollution was viewed. During the twenty minute running time, the video stressed the population's exposure to indoor pollutants, the large fraction (60%) of the workforce whose workplace is office buildings, and recent findings about the extent of susceptibility to indoor air pollutants. It went on to specify four types of indoor air pollution:

1) Pollution drawn in from outdoor sources, such as urban traffic or nearly industrial complexes;
2) Building materials (adhesives, insulation, finishes) and furnishings (plasticizers, etc.);
3) Reproduction fluids and cleaning agents;
4) Building occupants (sources of biological pollution).

Three kinds of remediation were presented by the video:

1) Dilution (with outside air);
2) Removal (by exhausting or filtering);
3) Prevention, via proper design, furnishing, operation and maintenance.

Following the video viewing, the Task Force discussed the options that might be feasible for Maryland. Senator Hoffman led by enumerating the courses of action <u>not</u> promising for the State namely:

a) Maryland does not possess, either itself or via EPA, the dose-response data that would be a necessary foundation for promulgating indoor air quality standards;
b) The State has no legal footing for itself monitoring air quality in homes and businesses;
c) Regulations and education can reduce, but not fully safeguard against, random failures (such as the slow roof leak belatedly detected in the Charles County school, as recalled by witnesses at the Task Force's recent hearing in Annapolis).

Turning to <u>plausible</u> State options, the Task Force considered the following:

a) State government ought to lead-by-example, both for purposes of technical demonstration and also as a role model;
b) Dialogue should be established with industry to explore the potential for joint State-marketplace roles in indoor air pollution control. For example, Honeywell reportedly will, under contract, operate and maintain HVAC systems in schools and office complexes. The incentive for this is purportedly lower overall costs to local governments than if they performed this work "in-house".

Further grounds for possible State-private cooperation might consist of voluntary, jointly-sponsored courses for builders, architects and maintenance engineers. Demonstrations and hands-on approaches would be included. Funding might use State start-up money, with the private sector taking over expenses for operation. Direct all features of the existing 13-week BOMA course for architects, appraisers, etc., could be scrutinized for possible inclusion in joint State-private courses in Maryland.

The objective of courses is voluntary participation. Certification of realtors, builders, building managers, etc., should be avoided, as this is generally viewed with suspicion (that is, to be used as a barrier to prevent free flow of new people with a profession or market niche).

c) Present technical inability to perform reliable, long-term indoor monitoring should not be regarded as an impasse with regard to the State's starting into substantive remediation efforts. Elaborate criteria or regulations can be avoided, because general guidelines would be an improvement over the rudimentary ventilation requirements now in most county codes. For instance, Baltimore County's code stipulates only that buildings must have windows that can be opened.

As a possible starting point, indoor ventilation rates can be evaluated, as some Maryland schools are beginning to do. Initially targeting ventilation rates, and perhaps relating them to the ASHRAE "80%" subjective air turnover guidelines, would be a more fruitful approach than trying to quantitatively deal with exposures to 400 indoor pollutants (particularly, when synergistic effects, temperature and humidity must also be taken into account).

d) Qualitative Standards should also be utilized, for example, "no smoking" rules.

e) A working-level administrative pollution control framework should be set up within State government. For example, agencies could identify an "abatement coordinator" for each State building (as a collateral duty). His job would be to receive complaints, and to initiate and track the remediation process. If it proved worthwhile, such a program might lead to voluntary adoption of similar steps by the private sector.

f) Another step the State might take would be to promote a standardized methodology for dealing with (the large variety) of indoor air pollution problems. Its elements might be:

i) Identify the problem;
ii) Assess the problem's impact;
iii) Compare incremental costs of remediation options, including estimates of long-term public health costs.

g) Hopefully, the State could develop preventive mechanisms for dealing with indoor air pollution. That is, in the design, furnishing and building rehabilitation processes. It could be more cost-effective than to remediate, if say, architects, interior decorators, HVAC engineers, consulted with State indoor air quality experts from the outset.

h) Attacking the problem from the opposite end, that is, the receptors, might also be useful. The State might assist with a screening program to identify people with high sensitivity to indoor air pollutants.

Candidates for the Task Force's short range objectives were suggested. These are:

1) Request the Department of the Environment to compile lists of possible recipients for information about indoor air pollution;
2) Survey the availability of less-offensive alternatives to commonly-used cleaners, reproduction fluids, etc.;
3) State buildings whose occupancy exceeds a certain trigger level should have an occupant who is qualified to perform temperature, humidity and flow rate measurements;
4) Devise mechanisms for awarding school maintenance contracts to private firms (when included in school budgets for in-house performance of maintenance, these funds often get "raided" for other purposes;

5) Explore whether rental agreements can have a clause requiring landlords to periodically adjust an service HVAC systems;

Chairman Farrell requested the Task Force Committees on:

1. Public Education/Awareness
2. Standard Operating Procedures
3. The State as a Role Model

to develop detailed recommendations for the Committee (to include those options discussed during the present meeting). Preliminary recommendations should be submitted well in advance of the General Assembly's legislative session, to allow for further refinements.

The next meeting of the Task Force was scheduled for November 16, 1989. The meeting was adjourned at 5:10 p.m.

Respectfully submitted,

Myron Miller

Approved at 1/18/90
IAQTF meeting.

MINUTES

Governor's Task Force on Indoor Air Quality

Meeting of November 16, 1989

Chairman Farrell called the meeting to order at 3:00.

MEMBERS IN ATTENDANCE

Allen Abend
Alvin Bober
Max Eisenberg
Don Elliott
Katherine Farrell
Tony Fulton
Al Heaver
Jeffrey Herring
Thomas Hobbins
Barbara Hoffman
William Hubalek
Ronald LeClair
James Miller

OTHERS PRESENT

Karen Pushkar
Myron Miller
Bruce Lippy
Jeff Paull
Gloria Peterson
Janette Gaydovchik
Dan LaHart

Following approval of the previous meeting's minutes, Dr. Farrell introduced Mr. Bruce Lippy, Aerosol Analysis, Inc., who gave a twenty minute presentation on "State-of-the-Art in Indoor Air Monitoring".

Offering a perspective for examining possible State actions, Mr. Lippy stressed that much money can be spent on long term monitoring for trace concentrations of indoor air pollutants, and still not obtain convincing insights for pollutant-specific abatement. Rigorous, detailed, precise, pollutant specific monitoring so seldom results in a timely, site-specific blueprint for remediation, that it has largely fallen from favor among the more experienced consulting firms. (But striking and serious exceptions to this are biological agents for instance, Legionella.)

One can trace several reasons why this "careful-but-pedestrian" approach is not usually fruitful:

1) Industrial hygienists are trained to work with high pollutant concentrations (inducing acute symptoms) for short exposure durations, while most indoor pollution is at low level, presenting long exposure (and chronic, sometimes subtle, symptoms).

2) Detection can be confounded because the pollution can be intermittent, and because not all people with symptoms complain.

Foundations for an alternative remediation strategy emerge when one broadly classifies the sources of pollution: 10% from outside sources, 18% from inside sources and 50% from inadequate ventilation (the latter in the absence of any particular "exotic" pollutant). This suggests the following remediation protocol:

Step #1. Search for the likely sources:

a) Check the location of air intakes. For instance, are they located near a dumpster, the exhaust from another building, or open onto heavily trafficked streets?

b) Examine the building's own exhausts, especially from combustion sources. Are there pathways whereby the exhausted air can be inadvertently recirculated? In this check, also give particular attention to the circulation and fate of indoor sidestream smoke from cigarettes.

c) Search for interior sources, including:

i) Carpets (it is recommended that these be given an outgassing period in a warehouse or other unoccupied place).

ii) Interior office partitions;

iii) Work station finishes;

iv) Fiberglass ceiling tiles;

v) Biological agents, like Legionella, that can inhabit ventilation system cooling towers or humidifiers.

vi) If none of the likely candidate sources is found to be a strong pollution source, then resort to broad-spectrum monitoring. Use the simplest and cheapest methods, for example, measure total volatile organic compounds (VOC). Aside from being cheaper, this methodology is also more relevant from an occupant distress standpoint. Studies support 1.5 parts per million as a VOC level that will annoy some occupants. Concentrations of 3 parts per million are clearly too high.

Step #2. Interview Personnel:

Experience has shown that approximately 20% of building occupants are dissatisfied with their air quality, regardless of its pollutant concentrations. (Temperature and humidity are confounding influences). The ASHRAE proposed subjective (80% acceptance level) standards reflect this rule of thumb.

Step #3. Assess the Ventilation System:

a) Frequently, building renovations have occurred, and piecemeal modifications have hurt the effectiveness of the air handling system.

b) Maintenance of ventilation systems tends to be either very good or very bad.

c) Techniques to check on interior circulation:

i) Smoke tracers (are cheap and effective, but constitute an objectionable pollutant themselves, and must be used during off hours);

ii) Streamers or other ventilation indicators at duct outlets;

iii) Carbon dioxide concentrations are useful indirect indicators of ventilation rates. In urban areas, 330 parts per million (and rising) is the typical outdoor carbon dioxide concentration. Complaints begin when indoor carbon dioxide concentrations reach the 600 to 800 parts per million range.

#4. Some Specific Recommendations

1) Be guided by the ASHRAE air-turnover standards (80% acceptance) once they become formalized.

2) Consult buying guides in order to avoid "gassy" products for interior finishes and furnishings.

3) It is worthwhile to properly train buildings' engineering operators.

4) In surprisingly many instances, excellent benefit to cost ratios can be achieved by averting outright blunders like locating garbage dumpsters next to air intakes.

5) The longstanding argument against generously increasing building air turnover rates is that it raises heating and cooling costs. Generally, maintaining ventilation rates for adequate indoor air quality does raise annualized building operating costs by roughly 5%. But to not ventilate properly is a diseconomy. Business space annual operating costs are $1 to $10 per square foot, (5% of which represents 5 to 50 cents per year per square foot). Contrasted to that is the cost of employees per square foot, typically $100 to $1000 annually. Even minute gains in productivity will more than compensate for the cost of providing better ventilation.

Chairman Farrell next introduced Mr. Ron Eclair, a hygienist with Maryland's Division of Occupational Health. He explained that Maryland has an acceptable State Plan (for occupational air quality) and has been delegated responsibility by the federal government. The Division will provide consultation for homes and industries (the latter for a fee). Landlords, for example, can request inspections and suggestions for remediation. In occupational settings, the State can be invited by either employer or employees. Part of the remediation not to be overlooked is to establish better communication between employer and employees.

In the field, Occupational Health analyzes per occupant air turnover rates using: irritant smoke generators, directional air velocity meters, detector tubes, shrouded velometers and psychrometers. Volume flow rates measured at system intakes and locally throughout a building, together with occupant densities, are employed to determine recommended system balancing (if indeed, the system is capable of being balanced). Frequently, less powerful analyses are needed: for example, its often a matter of work areas simply getting too hot near high powered communication equipment.

Mr. Eclair made several observations and recommendations, in part reinforcing those of Mr. Lippy, namely:

1) Institute rigid "No Smoking" policies;

2) Each building's occupants, and private/public air quality consultants, should know the individual responsible for the day-to-day upkeep and operation of that building's air handling equipment ("Herb" to the trade).

3) As a rule, less than an in-depth survey is needed to disclose an effective remediation plan. In the occupational health field, violations are corrected at the expense of the plant owner.

4) Occupational Health has just finalized a booklet giving guidelines on desireable indoor air ventilation rates and practices. This could be more broadly distributed through a campaign by other agencies in State and local government.

5) Improper ventilation and poor maintenance more frequently are at the root of indoor air quality problems than are design flaws in a building's original air handling apparatus. It is also bewildering to find how often smoking and non-smoking areas are connected to common ventilation systems.

6) In considering ways of providing more technical outreach of localities, the State should be mindful of a distinction between the needs of large and small counties. The former need to develop trained in-house staff, whereas the latter need to learn enough to hire appropriate consultants on indoor air quality matters.

7) Readily recognizable trouble indicators include:

i) Damp air;

ii) Molds, mildew and discoloration due to water damage;

iii) Biological agent densities in excess of 6000 per cubic meter often signal trouble.

Chairman Farrell characterized two features that the Department encounters when assisting with remediation by the private sector:

1) Strong complaints often lead to voluntary remediation (sometimes with, and sometimes without governmental "good offices"). This removes some of the impetus for a stronger governmental role, particularly when government traditionally shies away from regulating within households and businesses.

2) Situations that have proven hardest to deal with on voluntary bases arise when pollution passes between different occupants of a single building. For example, print shops or beauty parlors are not uncommonly sources of pollution. When no property lines are crossed, polluting of a fellow tenant's air is not presently illegal in Maryland. Another complication in such cases is how does one tenant persuade another towards remediation? Who, ideally, should be fined for polluting, the tenant or the landlord?

The Subcommittee on the State as a Role Model requested that a seventh recommendation be added to the six already submitted in writing, this would be: State industries should construct furniture with low-emitting materials and closed edges.

The Chair thanked the speakers for their presentations and commended the Subcommittees for promptly submitting written recommendations. The meeting adjourned at 5:10.

Respectfully submitted,

Myron Miller

State of Maryland

DEPARTMENT OF THE ENVIRONMENT

2500 Broening Highway, Baltimore, Maryland 21224
Area Code 301 • 631-

William Donald Schaefer
Governor

Martin W. Walsh, Jr.
Secretary

MEMORANDUM

TO: Indoor Air Quality Task Force
Interested Parties

FROM: Katherine P. Farrell, M.D., M.P.H.
Chair, Governor's Task Force on Indoor Air Quality

RE: Final Task Force Report

DATE: June 20, 1990

****

Recently, text for the final report of the Indoor Air Quality Task Force was sent out for printing and binding. This report should be ready for distribution to you by August 1, 1990.

KPF:lj

2025 6909

State of Maryland

DEPARTMENT OF THE ENVIRONMENT

2500 Broening Highway, Baltimore, Maryland 21224
Area Code 301 • 631-3918

William Donald Schaefer
Governor

Martin W. Walsh, Jr.
Secretary

October 31, 1990

Mr. Michael S. Miller
Maryland State Law Library
Courts of Appeal Building
361 Rowe Building
Annapolis, MD 21401-1991

Dear Mr. Miller:

The Maryland Department of the Environment is pleased to make the document entitled "Indoor Air Quality: A Common Sense Approach" available to you. Pursuant to Resolution No. 6 of the Acts of 1989, this document was prepared by the Governor's Task Force on Indoor Air Quality.

I hope you find this document interesting and helpful.

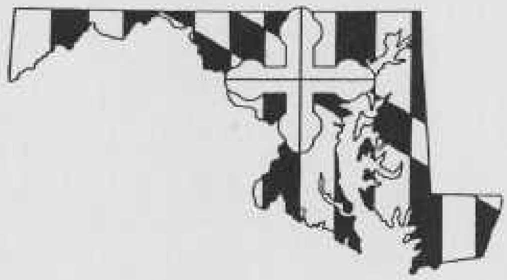
Sincerely,

Karen L. Underwood

Karen L. Underwood
Special Assistant
Toxics, Environmental Science
and Health

KLU:ltp
Enclosure

INDOOR AIR QUALITY:
A Common Sense Approach



STATE OF MARYLAND
INDOOR AIR QUALITY
TASK FORCE

Report to the Governor
and General Assembly

Presented by

The Governor's Indoor Air Quality Task Force
Dr. Katherine Farrell, Chair

May 1990

State of Maryland

DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway, Baltimore, Maryland 21224
Area Code 301 · 631- 3084

William Donald Schaefer
Governor

Martin W. Walsh, Jr.
Secretary

May 15, 1990

The Honorable William Donald Schaefer
State House
Annapolis, Maryland 21401-1991

Dear Governor Schaefer:

In accordance with the Joint Resolution Nos. 12 and 16, Acts of 1988, please find enclosed a copy of the final report of the Governor's Task Force on Indoor Air Quality. Copies of this report have also been forwarded to the President of the Senate and Speaker of the House.

If you have any questions or need further information regarding this report, please contact me at (301) 631-3084 or have a member of your staff contact Dr. Katherine P. Farrell, Chairman of the Governor's Task Force on Indoor Air Quality at (301) 631-3775.

Sincerely,

Martin W. Walsh, Jr.

Martin W. Walsh, Jr.
Secretary

MWW:lj

Enclosure

cc: Ms. Jane Nishida
Mr. Paul Schurick

State of Maryland

DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway, Baltimore, Maryland 21224
Area Code 301 • 631- 3084

William Donald Schaefer
Governor

Martin W. Walsh, Jr.
Secretary

May 15, 1990

The Honorable Thomas V. Mike Miller, Jr.
President of the Senate
H-107 State House
Annapolis, Maryland 21401-1991

Dear Senator Miller:

In accordance with the Joint Resolution Nos. 12 and 16, Acts of 1988, please find enclosed a copy of the final report of the Governor's Task Force on Indoor Air Quality.

If you have any questions or need further information regarding this report, please contact me at (301) 631-3084 or have a member of your staff contact Dr. Katherine P. Farrell, Chairman of the Governor's Task Force on Indoor Air Quality at (301) 631-3775.

Sincerely,

Martin W. Walsh, Jr.

Martin W. Walsh, Jr.
Secretary

MWW:lj

Enclosure

State of Maryland

DEPARTMENT OF THE ENVIRONMENT

2500 Broening Highway, Baltimore, Maryland 21224
Area Code 301 • 631-3084

William Donald Schaefer
Governor

Martin W. Walsh, Jr.
Secretary

May 15, 1990

The Honorable R. Clayton Mitchell, Jr.
Speaker of the House
H-101 State House
Annapolis, Maryland 21401-1991

Dear Delegate Mitchell:

In accordance with the Joint Resolution Nos. 12 and 16, Acts of 1988, please find enclosed a copy of the final report of the Governor's Task Force on Indoor Air Quality.

If you have any questions or need further information regarding this report, please contact me at (301) 631-3084 or have a member of your staff contact Dr. Katherine P. Farrell, Chairman of the Governor's Task Force on Indoor Air Quality at (301) 631-3775.

Sincerely,

Martin W. Walsh, Jr.

Martin W. Walsh, Jr.
Secretary

MWW:lj

Enclosure

ACKNOWLEDGEMENTS

The Governor's Task Force on Indoor Air Quality would like to express their appreciation to Martin W. Walsh, Jr., Secretary of the Department of the Environment for departmental support and cooperation, and the following speakers who gave presentations at Task Force meetings: Kevin Teichman and Robert Axelrad, both of EPA, and Bruce Lippy from Aerosol Analysis, Inc. A special thanks goes out to the public members who brought their indoor air quality concerns to the Task Force's attention at the public hearing held in September. The Task Force would also like to acknowledge the following people who played an active role in putting together this final report:

Myron Miller
Department of Legislative Reference

Karen Pushkar
Maryland Department of the Environment

Daniel LaHart
Maryland Department of the Environment

Etta Lyles
Maryland Department of the Environment

Frank Whitehead
Maryland Department of the Environment

John McQuade
Maryland Department of the Environment

Lynda Janak
Maryland Department of the Environment

Jeanne Supro
Maryland Department of the Environment

The following references were referred to when preparing this report:

EPA Report to Congress on Indoor Air Quality.
Washington, D.C.: U.S. EPA Office of Research and Development , Office of Air and Radiation.

Executive Summary and Recommendations
August, 1989
EPA/400/1-89/001A
Draft: January 1989
Final Report: August 1989
Volume II: Assessment and
Control of Indoor Air Pollution
EPA 400/1-89/01C
August 1989

Inside Story: A Guide to Indoor Air Quality. US/EPA/Office of Air and Radiation. EPA/400/1-88/004, September 1988.

Indoor Air Quality Diagnostics, Honeywell, Inc., Golden Valley, Minnesota.

Indoor Air Quality: Maryland Public Schools. Baltimore, Maryland: Maryland State Department of Education, November 1987.

Indoor Air Quality Management Program. Annapolis, Maryland: Anne Arundel County Public Schools, 29 March 1989.

The Bureau of National Affairs, Inc. Indoor Air Pollution: The Complete Resource Guide Volume I

INDOOR AIR QUALITY TASK FORCE MEMBERS

Katherine P. Farrell, MD, MPH, Chairman
Assistant Secretary
Maryland Department of the Environment

The Honorable Barbara A. Hoffman
Maryland State Senate

The Honorable Donald B. Elliott
Maryland House of Delegates

The Honorable Tony E. Fulton
Maryland House of Delegates

James W. Miller
Vice President
Private Industry Construction

Henry W. Kramer, Jr.
Senior Vice President
Private Industry Construction

Jefferson D. Herring
Chemical Industry Council

Allan B. Heaver
Building Owners and Managers Association

Arthur E. Wheeler, President
Technical and Professional Society or Association

Thomas E. Hobbins, MD
Public

William Hubalek
Public

Max Eisenberg, Ph.D.
Public

Alvin Bober
Department of Health and Mental Hygiene

Allen Abend, Chief
Department of Education

Ronald LeClair, Chief
Department of Licensing and Regulation

PREFACE

The Governor's Task Force on Indoor Air Quality was establish by 1988 Acts of the General Assembly (Joint Resolutions 6 and 12) to examine the extent of dangerous levels of air pollutants existing in homes and buildings and to make recommendations for improving indoor air quality. Also, the Task Force is charged with reporting their findings and recommendations to the Governor and General Assembly by January 1, 1990.

Prior to formally setting up Task Force, these Resolutions were referred to the Legislative Policy Committee where discussion ensued over whether or not the Indoor Air Quality Task Force should merge with the already existing Radon Task Force. Since the latter Task Force was close to finishing its findings and recommendations, the Policy Committee decided to set up the Indoor Air Quality Task Force.

Since formal, Task Force appointments were made in March 1989, a 90 day request for an extension of the January 1, 1990 deadline for submitting its report was made to and approved by the Governor.

The Task Force met monthly beginning in May 1989. At its first meeting, it was agreed upon that a common database of major pieces of information on indoor air quality be brought to the attention of all Task Force members. Along with sharing this database, IAQ expert speakers were brought in from federal and state agencies and private entities to share ongoing or planned activities relating to addressing the indoor air quality problem. With regard to obtaining input from public interest groups, a public hearing was held in September.

During subsequent Task Force meetings, information from these diverse sources was reviewed and factored into the findings and recommendations highlighted in this report.

The report is organized by chapters beginning with an Executive Summary. Chapter I is an indoor air quality primer covering pollution sources, health and economic effects, and means of control. Existing regulations and government indoor air quality programs are outlined in chapter 3. In chapter 4, the Task Force gives its recommendations for addressing Indoor Air Quality problems. To complement the report's chapters, appendices have been prepared. These appendices include, but are nor limited to a bibliography of Indoor Air Quality sources, a glossary and a directory of federal, state and private indoor air quality contacts.

TABLE OF CONTENTS

V. Appendices

EXECUTIVE SUMMARY

In 1988, the General Assembly requested the Governor to establish a Task Force on Indoor Air Quality. Specifically, the Task Force was charged with assessing Maryland's management of indoor air and recommending desirable State actions.

At this time, indoor air research has begun to characterize indoor air quality and it seems appropriate that the State role should be a nonregulatory approach. Sufficient evidence exists to conclude that indoor air quality is of major public health importance. Current evidence warrants an expanded effort to promote understanding of the management of indoor air quality including prevention and mitigation. The following general statements could serve well as the goals for all State activities related to indoor air quality:

* to adequately understand the risks to human health posed by poor indoor air quality, and

* to decrease those risks through appropriate design and efficient management of buildings.

A proactive posture is deemed more cost effective than wide scale monitoring of indoor air quality. Four considerations make up the primary framework for effectively decreasing indoor air quality problems. These include (1) design standards for new construction and major renovations; (2) maintenance and operations procedures that address indoor air quality; (3) periodic inspections of buildings, and (4) education and training programs.

The sources of indoor air pollutants are diverse and include naturally occurring radon, human activities such as smoking and cleaning, pest control, hobby activities; building materials such as pressed wood products and asbestos-containing materials, and combustion devises such as unvented space heaters and stoves, furnaces, and fireplaces. In addition to chemical pollutants, there are also biological pollutants. Indoor air quality problems can arise in any buildings including homes, offices and other public buildings, and schools.

There are many abatement techniques that may prove effective, depending on the particular indoor air pollutants and building types. In some cases, improved ventilation may be the most effective while in other cases, source control may be the most appropriate. Examples of source reduction and control could include smoking restrictions, local exhaust ventilation or better choice of products or materials. Yet, in other cases, changes in the behaviors of building occupants may bring about the most improvement in indoor air quality.

A comprehensive indoor air management program should be implemented by building owners and managers. This program should include:

(1) Design standards for all new construction and major renovations to existing buildings.

(2) A preventive maintenance program that specifically addresses indoor air quality issues.

(3) Training programs for maintenance, operations, planning and design staff.

(4) Systematic survey of all facilities with periodic reinspection.

(5) A policy to restrict tobacco smoking to adequately ventilated areas.

The Indoor Air Quality Task Force makes recommendations which are divided into five categories and are summarized below. Some of these recommendations should be implemented as soon as possible while others will require a longer implementation period.

1. **Maryland Schools**: The Maryland State Department of Education should continue to provide and expand its various indoor air quality programs.

2. **Education, Training and Outreach**: The State should concentrate on outreach, education and awareness actions rather than regulatory programs. The Maryland Department of the Environment should serve as the lead agency in coordinating indoor air quality programs.

3. **Design, Construction and Renovation**: Early planning for indoor air management in the design, construction and renovation of buildings can promote better indoor air quality.

4. **Facility Operations and Maintenance Procedures**: A comprehensive facilities management program that addresses indoor air quality should be established in facilities to properly manage scheduled maintenance, repairs, minor alterations to facilities, as well as guide the reaction to unscheduled breakdowns.

5. **State as a Role Model**: Several State agencies should work cooperatively to develop a comprehensive indoor air quality management program in buildings under the State's authority. Also, an indoor air quality oversight committee should be established for the purpose of monitoring and coordinating the implementation of these recommendations and reporting to the Governor on additional steps that need to be taken.

CHAPTER 1

INDOOR AIR QUALITY

IMPORTANT TERM:

Indoor Air Quality: **THE NATURE OF AIR THAT AFFECTS THE HEALTH AND WELL-BEING OF BUILDING OCCUPANTS.**

INTRODUCTION

Individuals are exposed to a variety of air environments as they progress through the course of their daily activities. The environment at home, in transit, at school, at work, and in recreational facilities all contribute to an individual's total exposure.

People spend approximately 93% of their time indoors, 2% outdoors, and 5% in transit (e.g. car, train, bus). Indoor environments dominate the total exposure spectrum.

Indoor air quality can typically be discussed under two categories: (1) **indoor climate** and (2) **chemical and biological constituents**

FACTORS AFFECTING INDOOR AIR QUALITY - INDOOR CLIMATE

IMPORTANT TERMS:

Thermal comfort: That condition of mind which expresses satisfaction with the thermal environment.

Air conditioning: The process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet the requirements of the conditioned space.

The indoor climate involves several variables that cause relative degrees of human comfort or discomfort. These include air temperature, radiant heat, humidity, and air movement. Adverse conditions can create discomfort for building occupants and staff and, in turn, affect the quality and the productivity of those individuals.

Satisfaction with the indoor climate is based on a complex, subjective response to several interacting variables. The design, construction, and use of an occupied space, as well as the design, construction, and operation of its heating and air conditioning systems, will determine the degree of comfort.

Not all individuals accept the indoor climate to the same degree. The perception of comfort relates to an individual's physical activity, body heat exchange with the surroundings, and physiological characteristics. It may also be influenced by psychological factors. The heat exchange between the individual and surroundings is influenced by:

* air temperature

* thermal radiation

* relative humidity

* air movement

* amount of clothing

* activity level

* direct contact with surfaces not at body temperature

While ideal conditions are complicated to define for any one individual in particular setting, The American Society of Heating, refrigeration and Air Conditioning Engineers (ASHRAE)has produced a consensus standard (Thermal Environmental Conditions for Human Occupancy, ASHRAE 55-1981) based upon experience and research that specifies conditions likely to be thermally acceptable to at least 80 percent of the adult occupants of a space.

A more complete explanation of the conditions, factors, affecting comfort, and the methods for their determination and measurement can be found in the ASHRAE Standard. **Figure 1-1** is taken from the standard and summarizes the generally acceptable comfort ranges of temperature and humidity for lightly clothed, mainly sedentary adults.

Studies comparing the basal metabolic rate of children from kindergarten to high school with those adults in the same environment show that it is not rare to find the comfort levels for pupils and teachers separated by at least 5 degrees Fahrenheit (°F). With the exception of very young infants, children are generally more comfortable in somewhat cooler temperatures due to their higher metabolic rate.

FIGURE 1-1 OPERATIVE TEMPERATURE

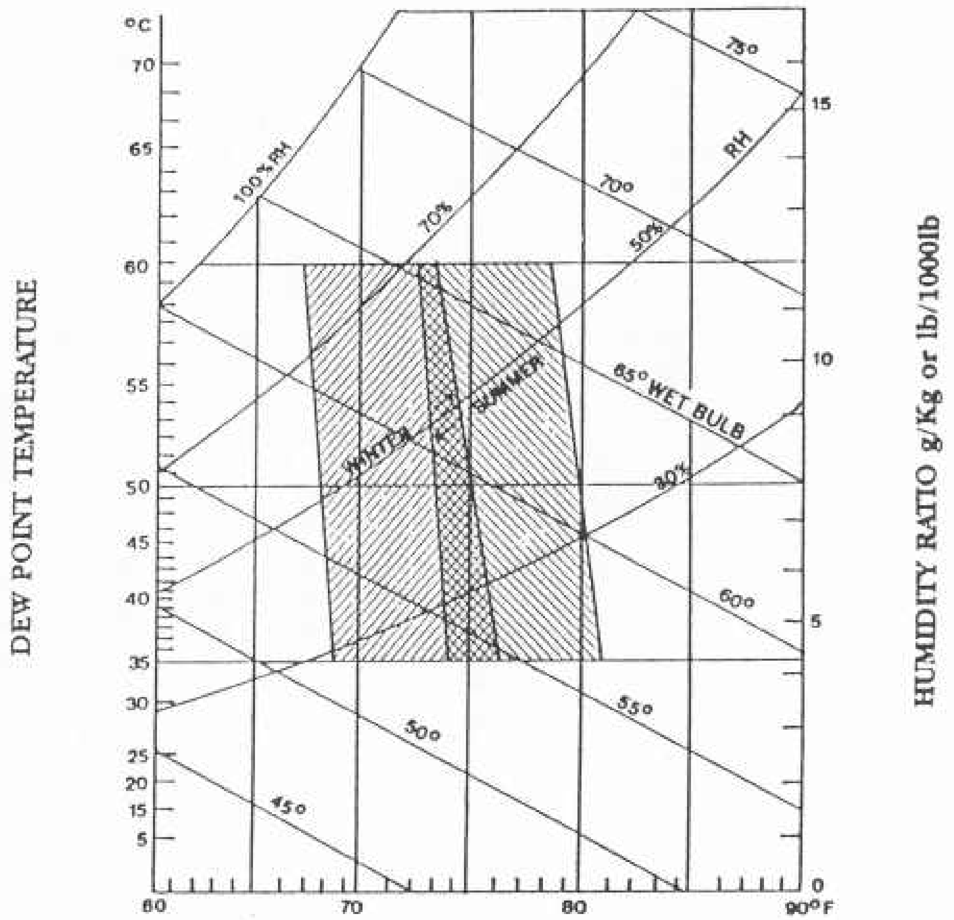


Figure 1-1 is taken from the ASHRAE standard and summarizes the generally acceptable comfort ranges of temperature and humidity for lightly clothed, mainly sedentary adults.

A description of those factors which most commonly influence the indoor climate is discussed below.

DESCRIPTION OF FACTORS INFLUENCING THE INDOOR CLIMATE

AIR TEMPERATURE

The air temperature in a space that is likely to produce acceptable comfort to a majority of occupants is dependent upon several variables. These include individual physiology, clothing, activity, and preference. For classrooms and offices where occupants are mainly sedentary, 68 to 76 degrees Fahrenheit (°F) represents a range of acceptability during winter. During summer, a higher range will be acceptable.

RADIANT TEMPERATURE

The body transfers heat to and from surrounding surfaces,such as walls or windows, by radiation. The rate of exchange is dependent upon the temperature difference between the body, the space geometry, building construction, and the location of the individual. A space enclosed even partially by cold walls will require a higher air temperature for comfort than one with surfaces at space temperature, especially for those seated near the cold surfaces. For example, persons seated near a large window without drapes or shades will notice radiant heat loss to that surface during cold weather. They will generally prefer a warmer room farther away from the outside wall. Heat gain or loss by the body by radiation may be asymmetrical (e.g., heat gain on the back, but not the front or vice versa). Discomfort can result regardless of adjustments in air temperature. This can occur where a person is seated in direct sunlight or close to a large, unheated or unshaded single-pane glass window.

UNIFORMITY

Air temperature within a room generally increases from floor to ceiling. If the temperature at the head is more than 5 °F higher than near the floor, discomfort may result. Good air mixing, and insulation of wall and floor surfaces can reduce temperature differences.

FLOOR TEMPERATURE

To minimize foot discomfort, the surface temperature of the floor should be between 65°F and 84°F. Floors of occupied spaces above unheated areas require insulation. Similarly, floors above boiler rooms may require insulation, both for foot comfort, and to control heat gain to the space above.

TEMPERATURE CHANGE

Some space temperature controls can produce rapid rates of change in the operative temperature (as defined by ASHRAE) of a space that will cause discomfort. For example, a prolonged off cycle for a control of a heater on an outside wall could result in down drafts at the wall and cooling in the lower level of the occupied area close to the wall. If a heating/cooling system is controlled by thermostat, then it should be located away from sources of unusual heat or cold such as windows.

HUMIDITY

The comfort effect of humidity on sedentary individuals is small. If the humidity level is too high, concerns may arise over mold or bacteria growth, if too low there may be respiratory drying effects. It is usually necessary to limit humidity levels in winter to prevent condensation on windows, metal sash and uninsulated walls.

AIR MOVEMENT

While little or no air movement may be necessary to achieve thermal comfort, the dilution of contaminants within the occupied areas or subareas will require effective dilution with adequate amounts of outdoor or recirculated air appropriately conditioned by filtration, purification or both. Supply and return air distribution systems serving occupied zones should be designed and operated to achieve effective ventilation and temperature uniformity during all operating modes during the occupancy period. In winter, average air movement above 30 feet per minute in the occupied zone may result in uncomfortable drafts.

CLOTHING

The insulation value of clothing varies depending upon the season and the outdoor climate. The insulating value of indoor clothing worn in winter can be twice that worn in summer. Thus, the comfort range of operative temperatures is higher in summer than in winter. Since this shifting of the comfort temperature range is usually consistent with energy conservation it also is a sound basis for operation and where necessary, seasonal adjustments of thermostat settings. Additionally, appropriate attire to the season should be encouraged to promote comfort and effective energy use.

ACTIVITY LEVEL

The range of comfortable operative temperatures shift downward as physical activity level and metabolic rate become higher than the level for lightly clothed, mainly sedentary activity upon which Figure 1 is based. For equal clothing insulation, building areas with higher levels of activity than the average office or classroom could have comfort ranges 3°F below the typical office or classroom. However, this shift in the comfort range could be materially offset by shedding some clothing as physical activity increases.

ZONING

Building spaces with dissimilar heating and cooling load characteristics, such as the amount of window exposure, occupancy patterns, and internal energy sources should have an independent means of temperature control. Interior spaces generally should not be on the same temperature control as spaces on the perimeter of the building. For example, depending upon the season, interior spaces may require cooling while perimeter spaces may require cooling or heating. Interior spaces, such as offices, should be grouped on a common thermostat when the thermal load characteristics and occupancy profiles are quite similar. Classrooms, libraries, and gymnasium should have separate thermostats.

Where a satisfactory indoor climate must be provided for certain sections of a building at times when most of the building is unoccupied and unused, separate systems with independent controls of heating and cooling will be necessary. For example, it would be uneconomical to air condition or heat an entire building when only office staff may require comfort conditions.

FACTORS AFFECTING INDOOR AIR QUALITY -CHEMICAL AND BIOLOGICAL CONSTITUENTS

Concentrations of constituents in the indoor air are dependent on (1) the indoor source and emission rate, (2) dilution factors (3) the concentration of pollutants in the outdoor air, and (4) rates at which the pollutants are removed from or chemically transformed in the indoor environment.

1) TYPES OF CONTAMINANTS AND THEIR SOURCES

Indoor sources include a variety of building materials, furnishings, combustion devices, a variety of consumer and commercial products, as well as human occupants and their pets. Emission rates of volatile organic compounds and some commercial and consumer products often increase under the conditions of high temperature and humidity, but generally decrease with time.

Indoor air constituents can emanate from a broad array of sources that can originate both outside and within the building. Knowledge of contaminant sources is critical for the development of effective management strategies. Internal sources include but are not limited to: combustion appliances, consumer and commercial products, building materials and furnishings, pesticides, HVAC systems, mold or water damaged materials, human occupants and pets. Personal activities such as smoking, cleaning, gluing and cooking also contribute. External sources include soil, water supplies, and the ambient (outside) air. The relationship between pollutants and their sources may be complex.

For example most sources do not emit single pollutants, but generate a mixture. Hundreds of specific airborne pollutants have been detected in varying concentrations in indoor environments. These can be grouped into a smaller subset of pollutants and pollutant classes as shown in Table 1-1.

TABLE 1-1

Indoor Air Pollutants of Concern
Radon and Radon daughters
Environmental Tobacco Smoke
Biological contaminants
Volatile Organic Compounds (VOCs)
Formaldehyde
Polycyclic Aromatic Hydrocarbons (PAHs)
Pesticides
Asbestos
Combustion Gases
Particulate Matter (Particles)

Table 1-2 presents a summary of typical indoor air contaminants and provides a better means of cross comparison and reference.

Description of Contaminants (Table 1-2)

	DESCRIPTION	SOURCES	STANDARDS & GUIDELINES
ASBESTOS	Asbestos is composed of small natural mineral silicate fibers.	Widely used in Insulation and other building materials until recently. The use of asbestos-containing spray-on materials is banned in U.S. buildings today.	A safe level of asbestos fibers h not been established. A standa for the assessment of asbestos material and selection of an appropriate action will be deta In the final federal regulations (October, 1987) under the Asbe Hazard Emergency Response A of 1986 (AHERA). AHERA also provide a clearance level for abatement projects now propo at no higher than .005 f/cm^3 o using transmission electron microscopy (TEM).
TOBACCO SMOKE	Tobacco smoke consists of solid particles, liquid droplets, vapors and gases resulting from tobacco combustion. Particles of condensed combustion products are almost in the respirable range and over 4,000 specific materials have been identified in the particulates and associated gases.	Tobacco Combustion	No general levels have been agreed upon. ASHRAE Standar 62-1989 specifies dilution with smoke-free air in quantities of 1 60 cubic feet per minute (cfm) p person depending upon the typ of space and the anticipated incidence of smoking.
RADON	Radon is a radioactive gas, the first decay product of Radium-226. It decays into solid alpha emitters which can be both inhaled directly or attach to dust particles which are inhaled. The unit of measure for radon is picocuries per liter (pCi/1).	Radium is ubiquitous in the earth's crust in widely varying concentrations. Well water can also have high concentrations of radon. Masonry building blocks can have radium concentrations. The earth around buildings however is the principal source of indoor radon. Radon penetrates cracks and drain openings in foundations, into basements and crawl spaces. Water containing radon will outgas into spaces when drawn for use indoors. Some building materials will outgas radon, some of which may enter buildings.	Organization and Radon level above which mitigating action is indicated (picocuries per liter). U.S. Mine Safety and Health Administration National Council for Radiation Protection and Measurements World Health Organization U.S. Bonneville Power Administration EPA State of Maryland ASHRAE Standard 62-1989
FORMALDEHYDE	Formaldehyde is a colorless water-soluble gas. Due to its wide use, it is frequently considered separately from other volatile organic compounds (VOCs).	Materials containing formaldehyde are widely used in buildings, furnishings, and consumer products. Urea-formaldehyde resins are used in the manufacture of plywoods, particleboards, and textiles. The walls of some buildings have been insulated with urea-formaldehyde foam insulation (UFFI). Formaldehyde outgases from the above mentioned products. Tobacco smoke and other combustion products are secondary sources. Indications are that in time outgassing diminishes from materials.	ASHRAE Standard 62-1989 does not include a specific level but sites Federal and State standard of 0.4 ppm. The Canadian action level guidelines is 0.1 ppm. The World Health Organization Working Group, concentrations of concern above 0.12 ppm.

Description of Contaminants (Table 1-2)

	COMFORT & HEALTH EFFECTS	MEASUREMENT METHODS	CONTROL MEASURES
ASBESTOS	No acute health or comfort effects due to asbestos are known. Fibers deposited in the lung are the only known cause of mesotheliomas, a fatal cancer of the pleual or peritoneal linings of the body. Asbestosis and other lung conditions also have been associated with asbestos exposures.	Phase contrast microscopy is used as a screening method for sampling asbestos fibers in the air. Fibers other than asbestos are also counted. Electron microscopy is a method which can distinguish asbestos definitively, but it is much more expensive than PCM and takes longer to complete. The proposed AHERA regulations require schools to use the TEM protocol for clearance samples for projects. Its use is phased-in through Oct 7, 1990.	Asbestos abatement In the U.S. is being handled as a special case separately from other air pollutants by U.S. agencies due to the perceived high public risk. the methods of abatement Include repair, removal, enclosure and encapsulation.
TOBACCO SMOKE	The effects of tobacco smoke on smokers are well known. However, many people who do not smoke object to smoke in their environments because of eye, nose and throat irritation. The health effect on non smokers has received increased attention. Acute health effects have been found in the lung function of children and spouse of smokers, allergic reactions occur in a small fraction of the population.	Particulate concentration Is measured by optical scattering or gravimetrically by particles collected on filters. Gas chromatographs are used to study gaseous components. Enough work has been done so that reasonable estimates of the source strength can be made by simply counting smokers and estimating the about 30% of adults smoke and consume about two cigarettes per hour.	Prohibition of smoking In public spaces Is becoming more common. Isolation of smokers is partially effective, but careful management of ventilation is required. If well applied and properly maintained, high efficiency air cleaners and gas filters are effective. Since very large ventilation rates are necessary to dilute smoke levels enough to be unobjectionable to most nonsmokers, dilution is often not totally effective.
RADON	No sensory perception or acute health effects are known. The chronic effect is lung cancer or other lung dysfunction due to the retention of radon decay products in the lung. These chronic effects are among the best known of all indoor pollutants, as the result of studies on uranium miners. It is speculated that non-occupational radon exposure in the U.S. may cause between 2,000 and 20,000 additional cancer deaths per year.	Inexpensive charcoal canisters (less than $15) are available to screen radon concentrations over a four to seven day period. Relatively inexpensive alpha track detectors (less than $50) are available for survey use which integrate radon concentration over a one month to one year period. Air sampling instruments for real-time measurements are more expensive. No inexpensive method exists to measure radon decay products concentrations.	Sealing of foundations to prevent entry has been demonstrated to be effective, although the long term reliability of sealing is unknown. Specific ventilation of basement areas and crawl spaces has also been shown to be effective. Increased ventilation with outdoor air will lower radon levels for a given building. However, radon levels do not correlate well with ventilation rates among different buildings; i.e., buildings with low ventilation rates will not necessarily have high indoor radon levels and vice versa.
FORMALDEHYDE	Formaldehyde has a pungent odor and is detected by many people at levels of about 0.1 ppm. Besides the annoyance, it also causes acute eye burning and irritates mucous membranes and the respiratory tract. Formaldehyde has also caused nasal cancer in laboratory animals, but chronic effects have not been established for human beings. Some people exhibit a high sensitivity to very small concentrations.	Inexpensive passive samplers and detector tubes have been developed. The more accurate method of collecting formaldehyde is by impingers. Concentrations are then determined by colorimetric methods.	For problem UFFI cases, removal is indicated although the cost can be high. Even then, residual materials may remain in the structure and continue to outgas. Increased temperature, humidity, and ventilation will accelerate outgassing. Therefore ventilation may not be an effective means for mitigation. Some manufacturers are producing products with lower outgassing rates. Some surface treatments are being used to seal against outgassing, but long-term effectiveness Is still being studied.

Description of Contaminants (Table 1-2)

	DESCRIPTION	SOURCES	STANDARDS & GUIDELINES
OTHER VOLATILE ORGANIC COMPOUNDS (VOCs)	There are hundreds of other volatile organic compounds that are found in the indoor air, sometimes in concentrations which are suspected of being harmful. Those listed below do not comprise a complete list. acetone - by-products of human metabolism, cleaners, personal care products, tobacco smoke acrolein - tobacco smoke alcohols - by-products of human metabolism, cleaners, personal care products, tobacco smoke ammonia - cleaners, tobacco smoke aromatic hydrocarbons -combustion processes, pesticides, paints, solvents, tobacco smoke benzene - combustion processes, gasoline, solvents, tobacco smoke chlorinated hydrocarbons - PCBs, wood preservatives, solvents organophosphates - pesticides phenols - equipment, furnishings, tobacco smoke toluene - adhesives, gasoline, paints, solvents, tobacco smoke.		No standards have been set for VOCs in non-Industrial settings. NIOSH has recommended occupational standards for many compounds. ASHRAE Standard 62-1989 includes a suggestion that in the absence of better data, the ACGIH limits be divided by 10. The World Health Organization Working Group, concentrations of concern are cited for a number of organic compounds.
NITROGEN OXIDES	The two most prevalent oxides of nitrogen are nitrogen dioxide (NO_2) and nitric oxide (NO). Both are toxic gases with NO_2 being a highly reactive oxidant, and corrosive. NO gradually reacts with the oxygen in the air to form NO_2	The primary sources indoors are combustion processes, such as unvented combustion appliances, vented appliances with defective installations, welding, and tobacco smoke.	No standards have been agreed upon for nitrogen oxides in indoor air. The U.S.National Ambient Air Quality Standards lists 100 ug/m^3 as the long term (8 hour) limit.
CARBON MONOXIDE	CO is a colorless, odorless, and tasteless gas. It results from incomplete oxidation of carbon in combustion.	Incomplete oxidation during combustion in gas ranges, unvented heaters, leaky wood and coal stoves, and tobacco smoke may cause high concentrations of CO in indoor air. Worn or poorly adjusted and maintained combustion devices can be significant sources. Automobile, bus, or truck exhaust entering buildings from attached garages, nearby roadways or parking areas can also be a source of CO.	No standards for CO have been agreed upon for indoor air. The U.S. National Ambient Air Quality Standards is 40 mg/m^3 for one-hour.
CARBON DIOXIDE	CO_2 is an odorless, tasteless, and colorless product of completed carbon combustion.	All combustion processes and the human metabolic processes are CO_2 sources. Concentrations of CO_2 from people and smoking are always present in all occupied buildings.	U.S. submarines operate at 7.000 ppm or less. The present ASHRAE Standard 62-1989 sets 1,000 ppm as the upper limit where CO_2 represents a surrogate for other pollutants. The outdoor level is usually 300 - 400 ppm.
BIO AEROSOLS	Biological material, bacteria, viruses, fungi, mold spores, pollens, and inset parts are ubiquitous in indoor environments. These particulates range from less than one to several microns in size. When airborne, they are usually attached to dust particulates of various sizes so that all sizes of airborne particulates may include them.	People and animals "shed" such materials. Drapery, bedding, carpeting, and other places where dust collects can harbor them. Cooling towers have been known to be incubators of Legionella bacteria. Dirty air-conditioning equipment, humidifiers, condensate drains, and ductwork can incubate bacteria and molds. High humidity areas exacerbate their growth.	No standards exist for general indoor air applications except that ASHRAE recommends a relative humidity between 30 and 60%.
BODY FLUIDS	Blood and body fluid spills such as vomit, urine, saliva, etc.	Usually children but may be any building occupant resulting from an illness or personal injury or chronic condition.	No standards have been set beyond good hygiene practices. Use of school based body fluid and first aid kits should be standard procedure. Follow good hand washing techniques.

Description of Contaminants (Table 1-2)

	COMFORT & HEALTH EFFECTS	MEASUREMENT METHODS	CONTROL MEASURES
OTHER VOLATILE ORGANIC COMPOUNDS (VOCs)	Several of these compounds have been identified individually as causing acute and chronic effects at high concentrations. Some have been directly linked to cancer in humans and others are suspected of causing cancer. The effects of combinations of the compounds at low concentrations have been suggested as causes of several "sick building" situations.	Gas chromatographs and portable photoionization meters are used for laboratory and field studies to measure VOC concentrations. No Inexpensive monitors are suitable for extensive field use currently exist.	Where practical, uses of these sources should be restricted, and these materials should be stored In well ventilated areas apart from occupied zones.
NITROGEN OXIDES	Oxides of nitrogen have no sensory effect in low concentrations. Acute effects of lung dysfunction have been reported at higher concentrations. Oxides of nitrogen produce immediate short-tern effects on airway activity. Persons at special risk are those with chronic bronchitis, emphysema, asthma, and children under 2 years old. Chronic effects are not well established.	Small inexpensive passive NO_2 monitors suitable for field use are available. Nondispersive infrared techniques are used to measure nitrogen oxides in laboratory settings or for continuous monitoring.	Venting the NO_2 source to the outdoors is the most practical measure for existing conditions. Manufacturers are developing devices which generate lower NO_2 emissions.
CARBON MONOXIDE	Acute effects are due to the formation of carboxyhemoglobln In the blood, which inhibits oxygen intake. At moderate concentrations, cardiovascular disease, impaired vision, and loss of brain function may result. At higher concentrations CO exposure is fatal.	Some relatively high-cost infrared-radiatlon absorption and electrochemical instruments do exist. Moderately priced real-time measuring devices are also available. A passive monitor is currently under development.	It is most important to be sure combustion equipment is maintained and properly adjusted. Vehicular use should be carefully managed adjacent to buildings and in vocational programs. Additional ventilation can be used as a temporary measure when high levels of CO are expected for short periods of time.
CARBON DIOXIDE	At concentrations above 10,000 ppm, some loss of mental acuity has been noted.	Instruments exist which are reliable and inexpensive for most commercial applications.	Ventilation methods are used to control carbon dioxide.
BIO AEROSOLS	Tuberculosis, measles, staphylococcus infections and influenza are known to be transmitted by air as is Legionnaires disease. Pollens and molds can cause allergic reactions for a significant portion of the population.	Air samples must be collected on appropriate microbial media and incubated for visual examinations of viable growths. Microscopic examinations of collected dust can be used to identify molds and pollen. No inexpensive field monitors exist which are suitable for large-scale use. Active sampling should be the method of choice (e.g., Anderson two-stage, impactor or impinger).	General good housekeeping and maintenance of heating and air-conditioning equipment are very important. Adequate ventilation and good air distribution also helps. Higher efficiency air filters remove viable particles along with other particulates. Cooling tower treatment procedures exist to reduce levels of Legionella and other organisms.
BODY FLUIDS	Immediate cleanup and disposal of any body spills should be practiced. With proper precautions in any cleanup, there should be no adverse discomfort or health effect on occupants.	None are applicable.	Maintenace staff should be provided with a body fluid spill and first aid kit. The spill kit should consist of a bucket, disinfectant, "barf-clean," disposable gloves, paper towels, sealable plastic bags, band-aids and gauze (for use by the person doing the cleanup) and a brush. Administrators should insure the kit is maintained with all these components.

MEASUREMENT

Some indoor constituent concentrations can be measured using monitoring instruments. These instruments vary from hand held portable monitors to large, stationary analytical monitors and may or may not require laboratory analysis.

(2) DILUTION FACTORS

(a) The role of ventilation:

IMPORTANT TERM:

Ventilation: The process of supplying and removing air by natural or mechanical means to and from any space. Such air may or not be conditioned.

Since indoor environments are contained in buildings (residences, offices, schools, etc.), the characteristics of buildings and the influence of building ventilation systems on indoor environments are of utmost importance in any effort to address indoor air quality. Buildings, in the broadest sense, are enclosed spaces that provide refuge and shelter from the exterior environment. Modern buildings perform this function extremely well. The health, comfort, and productivity of building occupants is greatly influenced by the design, operation, and maintenance of building ventilation systems.

(b) The role of outdoor air:

Outdoor air can be exchanged for indoor air through natural ventilation, mechanical ventilation, or through infiltration and exfiltration. Natural ventilation occurs when desired air flows occur through windows, doors, chimneys, and other building openings. Mechanical ventilation is the mechanically induced movement of air through a building. Mechanical systems usually condition and filter the air, and allow for the entry of outdoor air through air dampers. Infiltration and exfiltration are unwanted movement of air through cracks and openings in the building shell. A "tight" building is one in which infiltration and exfiltration rates are very low.

The exchange rate and mixing of outdoor air with indoor air affects indoor air quality. Dilution or replacement of indoor air prevents indoor air constituents from accumulating to high levels.

(3) THE CONCENTRATION OF POLLUTANTS IN THE OUTDOOR AIR

Outdoor pollutants or recirculation of indoor pollutants sometimes create severe indoor air quality problems because of inappropriately located intake vents. For example, vents which supply outdoor air into the building, may be located near a roadway or a parking lot. This can allow motor vehicle exhausts to enter the building air supply. Most often, however, these vents are located on the roof, for aesthetic reasons, they are often positioned on the back of the building which may overlook the loading dock or trash storage area, or may be located close to and downwind from the rest room exhaust of the building or an adjacent building.

In each case, unwanted air contaminants may be incorporated in to the building air. Thus, while the sources of the indoor air pollution problems are outdoors, the cause of the problem as can be traced to faulty design of the HVAC system, and inadequate consideration of the entrainment of pollutants from outside sources.

As a general rule, outdoor air concentrations, particularly in buildings with high outdoor induction rates, will act as the background level for the indoor environment. This is normally not a problem where ambient outdoor levels are acceptable and no major sources exist in the immediate vicinity of the building.

(4) RATES AT WHICH THE POLLUTANTS ARE REMOVED FROM OR CHEMICALLY TRANSFORMED IN THE INDOOR ENVIRONMENT

IMPORTANT TERM:

Air cleaner: A device designed to remove airborne impurities, such as dusts, gases, vapors, fumes, and smokes.

The role of air cleaners:

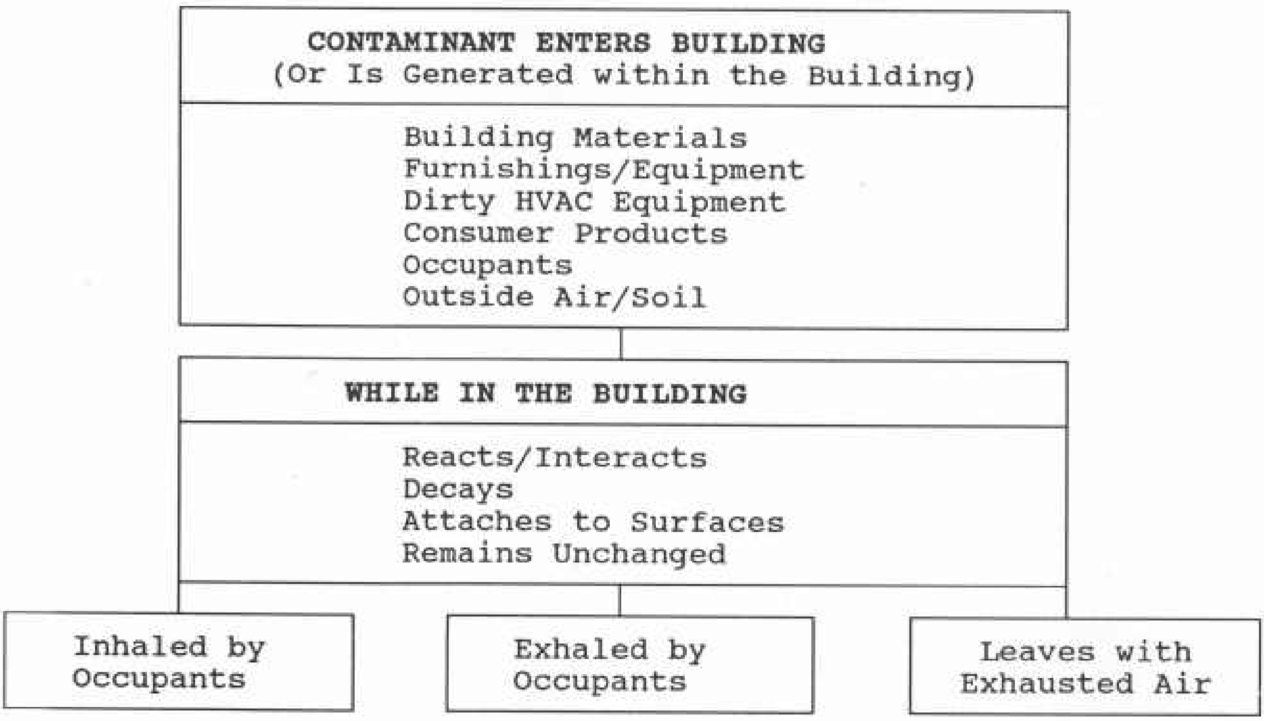
Air cleaners are routinely utilized for removing unwanted constituents from indoor air. Examples include: filtration devices, electrostatic precipitators, sonic air cleaners, ultraviolet light, ion chambers, charcoal adsorbers, and plants.

Pollutant removal mechanisms will lower indoor concentrations and improve indoor air quality. Pollutants can be removed from the outdoor air prior to entering the indoor space, or they can be removed directly from indoor environment. Removal mechanisms may be physical or chemical. They may be part of the natural reaction of the chemical with its surroundings, or they may deliberately incorporated into the building operating system. Air filtration devices are examples of a physical removal mechanism which is deliberately incorporated into most building ventilation systems.

Physical and chemical reactions of pollutants with their surroundings may take several forms: sorption or chemical reactions with building materials and furnishings; chemical reactions with other pollutants; and photo dissociation and catalytic reactions. For some pollutants, these reactions may be quite important. Concentrations of nitrogen oxides and sulfur oxides, for example, are heavily influenced by the reactive properties of these compounds. In fact, the EPA reports chemical reactions and sorption can reduce concentrations of nitrogen oxides 48% more quickly than dilution. It should be noted that the breakdown and/or decay of substances can produce other indoor contaminants. The constituents of tobacco smoke undergo many changes as it decomposes. With respect to dust particles, settling rates may determine their removal from indoor air. reentrainment may also occur.

The indoor pollutant flow shown in Figure 1-2 provides an overview of the contaminant's "life" in a building.

Figure 1-2. Indoor Pollutant Flow



This figure suggests that several contaminants and conditions related to indoor air quality could be operating at any given time.

HEALTH AND DISCOMFORT EFFECTS OF POOR INDOOR AIR QUALITY

IMPORTANT TERMS:

Acute exposure: Exposure to a contaminant usually measured in hours, minutes, or in some cases, seconds.

Acute health effects: Those health effects manifested almost immediately.

Chronic exposure: Repeated or long term exposure to a contaminant over a long duration usually measured in weeks, months, or years.

Chronic health effects: Health effects that develop or persist over a long period of time such as cancers, liver and kidney disease, etc.

Building related illness: Health effect that refers to a discrete, identifiable disease. Can be traced to a specific pollutant within a building. (Contrast with "Sick building syndrome.")

Sick building syndrome: Refers to a set of symptoms that affect a number of building occupants during the time spent in the building and diminish or go away when they leave the building. Cannot be traced to specific pollutants or sources within a building.

Sensitizer : A material that can cause an allergic reaction.

Toxicity: The degree to which a chemical agent produces a harmful effect on some biologic mechanism.

"Human exposure" guidelines for a limited number of air pollutants have been established. Table 1-2 summarizes the health effects of certain individual pollutants.

The potential health and discomfort effects of the major indoor air pollutants range from mild sensory irritation to serious toxicity, chronic organ damage, and death. The extent to which such effects actually occur depends on many factors, including the nature and degree of exposure and the susceptibility of the individuals exposed. While it can be generally agreed that indoor air can and does cause many adverse health effects, relationships between such health impact and actual population exposures are not well quantified.

THE POPULATION AT RISK

When evaluating the potential health effects related to indoor air quality, the following individual factors must be considered: age, sex, occupation, and health status.

The health status of the individual is important since many indoor air pollutants may aggravate past or present diseases. For example, individuals with lung disease such as asthma, bronchitis, emphysema, etc maybe made ill by exposure to respiratory irritants or sensitizers. Medication could affect response. There also are some individuals who are particularly sensitive to certain chemicals. The elderly may be more affected by pulmonary irritants and infections, and have a higher incidence of preexisting pulmonary disorders. Newborn and young children may also be especially sensitive to some air pollutants.

Although some acute chemical exposures can occur indoors due to spills and the misuse of chemicals, exposures in the indoor environment are generally characterized by the comparatively low concentrations of mixed pollutants. Typical concentrations of individual pollutants in the indoor environment are 100 to 1000 times below those sometimes found in the industrial workplace but may be 100 to 1000 times higher than those found in pristine outdoor air.

Responses to indoor pollutants (e.g.,headache, malaise, etc.) are often subtle, with the reactions not always immediately related to an air quality. Conversely, industrial workplace exposures are more commonly related to clear toxic reactions.

Pollutant Mixtures

Pollutants are not breathed in isolation, but are complex and changing mixtures. The health effects may be additive, synergistic, or antagonistic.

Pollutant mixtures may play an important role in causing symptoms associated with the "sick building syndrome" (see discussion below) (Molhave 1984). In a controlled experiment conducted at the Institute of Hygiene in Denmark, 62 human subjects were subjected to a mixture of 22 organic vapors and gases that are common in residential building materials, and which are known upper airway irritants. The subjects were all healthy, without asthma, allergy, or chronic bronchitis. They were selected from a group contacted via the press, all suffering from "indoor climate symptoms," primarily irritation of the eyes and upper airways (Bach, Molhave and Pedersen 1984). When exposed to a total concentration of 5 snf 25 mf/m^3 subjects showed significant mucous membrane irritation and memory impairment compared to exposure to clean air. These concentrations correspond to the average and maximum found in new Danish houses (Molhave 1984; Bach, et al., 1984). The concentrations of each of the individual experimental compounds were significantly below levelş generally thought to cause effects. Exposure experiments between 0 and 5 mg/m^3 were not conducted. Reactions to mixtures of organic gases and vapors may also depend on other environmental factors as well as individual disposition to such symptoms (Molhave 1984).

Building factors

In the 1970s, new energy-conserving building designs introduced tight shells, inoperable windows, and centrally controlled ventilation systems which could operate with minimal introduction of outdoor air. These designs, combined with indoor air sources cause increases in indoor air pollution levels. Complaints by building occupants have become more common. The physiological reactions to these pollutants, coupled with the psycho-social stresses of the modern office environment, and the wide range of human susceptibility to indoor air pollutants has led to some tentative classifications of acute building sickness: building-related illness, sick building syndrome, and multiple chemical sensitivity. These emerging problems are the subject of continued inquiry in the scientific and medical community.

Building-Related Illness

Building-related illness is a term which refers to an illness brought on as a result of exposure in a building. Frank illness, including infections, and other illnesses are identified and an airborne pathway for the stressor is recognized (NRC 1987). Legionnaires' disease and some forms of hypersensitivity pneumonitis are examples of building-related illness.

Sick Building Syndrome

Sick building syndrome is a term which refers to a series of acute health and comfort effects which are experienced by a substantial percentage of the building occupants, the onset and relief of which are associated with entering and leaving the building, and where no specifically defined illness or causative factor can be identified. Typical symptoms includes irritation of the eyes, nose, throat, skin, fatigue, headache, runny nose or asthma-like symptoms; and odor and taste complaints. Generally, sensory irritation dominates the syndrome; systemic symptoms are infrequent (WHO, 1983; Molhave, 1987).

Investigators of sick building syndrome are typically unable to identify any single exposure factor exceeding a generally acceptable threshold. The causality, therefore, is often assumed to be multifactorial, involving combined environmental and psycho-social stresses (Molhave 1984).

A full discussion of all the potential factors associated with sick building syndrome is beyond the scope of this report. Nevertheless, several studies of sick building syndrome in the United States and Europe offer some evidence of both building-related and psycho-social factors that may be associated with this problem. A major British study found higher prevalence of sick building syndrome complaints in air conditioned buildings (Hedge, et al., 1987; Harrison, et al., 1987). Among the air conditioned buildings, those with humidification systems, particularly spray or evaporative types, had the highest prevalence (Hedge, et al., 1987). However, only limited monitoring of air contaminants was conducted. Monitoring of air contaminants in the Harrison study was limited to particulate matter, fungi and bacteria, which did not correlate with symptom prevalence. No monitoring data were reported by Hedge.

A major multidisciplinary study in 14 Danish Town Halls (Skov and Valbjorn 1987; Valbjorn and Skov, 1987) found no association between sick building syndrome and ventilation characteristics, but found strong positive correlations with the age of the building, the total weight and potential allergenic portion of floor dust, the area of fleecy material, the open shelving per cubic meter of air, and the air temperature. The investigators also found higher health complaint rates to be associated with lower job status, being female, being involved in photoprinting activity, working with video display terminals, and handling carbonless paper.

Biological Constituents

Airborne biological constituents are present in all indoor and outdoor environments and come from a variety of sources, including soil, plants, animals, and humans. Bacteria and viruses are carried into the indoor environment mainly by humans or animals. Other indoor sources include air conditioners, humidifiers, and toilets, as well as water-damaged carpets or other furnishings. Room humidifiers in particular may function as fertile breeding grounds for microorganisms, and have been implicated in a number of cases of building-related illness. Molds and fungi may be brought in from outdoors and may proliferate in warm damp, dark indoor environments.

Microorganisms can be pathogenic (disease producing) or non-pathogenic. Non-pathogenic organisms do not generally infect human beings but some can invoke allergy or produce toxic byproducts.

Mycotoxins

Some molds are known to produce mycotoxins. These toxins produce direct toxic effects as well as immunosuppression. At low concentrations, some mycotoxins produce gastrointestinal illnesses and suppression of blood production. Toxicity to the central nervous system can produce symptoms such as loss of appetite sleeplessness, and nausea. Trichocene mycotoxins can produce non-specific symptoms such as those described in "sick building syndrome." (EPA 1987)

Some fungi also produce mycotoxins. The concentration of mycotoxins in the spores of toxigenic fungi is often very high. The effects of these poisons are primarily known from ingestion, but these toxins may have an effect when inhaled in high concentrations.

Pathogens

Some pathogens, (infectious agents) are communicated by airborne transmission. Examples include influenza, chicken pox, measles, the common cold, tuberculosis, Legionella and other forms of pneumonia which affect millions of people each year. An infected individual, is the source of the particular biological agent, and these health effects are typically not considered building-related (Kreis and Hodgson 1984). Nevertheless, airborne transmission of infectious agents is believed to be related to the ventilation of buildings; a recent study involving four Army training centers demonstrated that the rates of acute febrile respiratory disease were 50 percent higher in modern barracks (that had been constructed with energy-efficient designs) than in older barracks (Brundage et al., 1988). Most airborne pathogens are spread directly by person to person transmission but poor ventilation or the presence of airborne irritants can increase actual rates.

Some infectious bacteria, which proliferate in humidifiers, air conditioners, and in other building components, have been implicated in epidemics, including outbreaks of Legionnaires' disease, and Pontiac fever.

Legionnaires' disease is a form of pneumonia caused by Legionella pneumophila which, in addition to affecting the lungs, may also involve the gastrointestinal (GI) tract, the kidneys, and the central nervous system. This illness was first identified during an epidemic at a Legionnaires' convention in a Philadelphia hotel in 1976, which affected 182 persons and caused 29 deaths. Since 1976, numerous building epidemics have been associated with this bacterium. Approximately 1-7 percent of persons exposed to L. pneumophila become ill with Legionnaires' disease. Sources of the bacterium include aerosols from cooling towers, evaporative condensers, and humidifiers, and dusts from landscaping and construction activities (Kreis and Hodgson 1984). Legionnaires' disease is now readily treatable but can have serious consequences in susceptible populations like nursing home patients.

Pontiac fever, named after a 1968 building epidemic in Pontiac, Michigan, is caused by the same bacterium which causes Legionnaires' disease. Unlike Legionnaires' disease, however, Pontiac fever is a short term (two to five day) illness characterized by fever, chills, headache, and muscle ache, and sometimes coughing, sore throat, chest pains, nausea, and diarrhea. Pontiac fever is not fatal but nearly 100 percent of those exposed to the bacterium get the disease. No consensus exists as to why the same bacterial strain causes two distinct clinical syndromes. (Kreis and Hodgson 1984)

Allergens

Allergenic agents provoke an allergic (hypersensitive) reaction in a small subset of the population (Solomon and Burge 1984). While some chemicals known as sensitizers can provoke allergic responses, most allergens are biological and include both living organisms and breakdown products. Living organisms which provoke such responses include: molds, amoebae, algae, and bacteria. Nonviable agents include fecal material of house mites, cockroaches and insect and arachnid dried hulks and body parts, animal danders, nonviable remains of molds and their spores, dried animal excretions such as saliva, sweat, urine and feces, and pollens. Common allergic illnesses include allergic rhinitis, hay fever, bronchial asthma, and hypersensitivity pneumonitis (EPA 1987).

Allergic rhinitis is characterized by nasal air passage obstruction, itching, sneezing and excessive secretion of mucus. Allergic rhinitis is commonly referred to as "hay fever" when it is seasonally related. Irritation, itching, and reddening of the eyes, is often associated. Excessive mucus secretion and blocking of sinus and ear passages provide growth reservoirs where secondary bacterial infections may occur, thus predisposing individuals to bacterial infections in the upper airways (EPA 1987).

Bronchial asthma involves a recurrent narrowing of small airways secretion of thick mucus that can block airways. It causes varying degrees of wheezing, shortness of breath, and coughing. Secondary bacterial infections can result in bronchitis and more sensitive reactions to irritants and other allergens (EPA 1987).

Hypersensitivity pneumonitis (extrinsic allergic alveolitis) is an unusual and serious immune reaction to sensitizing substances. It involves the production of large amounts of IgE antibody, cellular hypersensitivity, and the formation of interstitial granulomas. It causes filling and variable destruction of the air sacs of the lung by inflammatory cells (EPA 1987). With continued exposure irreversible pulmonary fibrosis and eventual pulmonary failure, ending in death, ensues (Reed 1981, and Solomon and Burge 1981, as cited in EPA 1987).

SUMMARY AND IMPLICATIONS

Health effects from indoor air pollution cover the range of acute and chronic effects, and include eye, nose and throat irritation, respiratory effects, neurotoxicity, kidney and liver effects, heart functions, mutagenicity, and carcinogenicity. Noncarcinogenic health effects constitute the most significant indoor air quality problem.

Building sicknesses, such as sick building syndrome, building-related illness, and multiple chemical sensitivity are issues of potentially great significance but are poorly understood. Additive or synergistic effects from pollutant mixtures, where concentrations of each individual compound are below its known health effect threshold, may help to explain some sick building syndrome complaints. Biological contaminants are a principal cause of building-related illness and can be the principal problem in some buildings. Building-related illness can result in death, as in Legionnaire's disease, or serious infectious or allergic diseases. A considerable body of anecdotal evidence suggests that a small subset of the population has become sensitized to a wide variety of chemicals in the environment. This is referred to as multiple chemical sensitivity.

EXPOSURE STANDARDS

Few standards for indoor air contaminants have been established. Standards that do exist are the "occupational" standards for specific contaminants. A factor of 10 to 100 times less for indoor air is often used as an arbitrary standard.

Various governmental agencies and professional organizations have recommended guidelines are designed to protect the general public. Guidelines designed to protect the general public are uniformly more stringent than occupational guidelines. Occupational limits, are intended to protect a relatively healthy adult workforce, not the more sensitive individuals such as the elderly or very young. Occupational limits also assume exposure for the normal 40-hour work week. Exposure is assumed to be voluntary.

Public Health Standards and Guidelines

The Environmental Protection Agency (EPA) has developed National Ambient Air Quality Standards (NAAQS) for six outdoor air pollutants. These standards are designed to protect the general public, including susceptible population subgroups. They may be applicable for the indoor environment where protection of similar population is desirable but indoor air maybe of a collectively different nature than outdoor air.

The Hazardous Pollutant Evaluation Section of the State of Maryland's Air Management Administration has developed "screening" levels for toxic air pollutants and may be consulted concerning the use and derivation of these levels as well as for information on Maryland's Air Toxics Regulations. Although quite stringent, these too are targeted at outdoor air.

The World Health Organization (WHO), an agency of the United Nations, recently published air quality guidelines for 28 organic and inorganic substances. The guidelines are set to protect the public health, including susceptible population subgroups.

The Canadian Minister of National Health and Welfare published indoor air quality guidelines for nine pollutants or pollutant categories. Their application is intended for residential environments and are designed to protect the general public, including susceptible population subgroups.

The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) references the EPA NAAQS plus approximately 30 contamination limits selected from current practices of various states, provinces, and other countries (ASHRAE Standard 62-1989). **ASHRAE 62-1989 VENTILATION STANDARD** is the primary standard for providing acceptable indoor air quality and minimum ventilation rates in buildings which will be acceptable to human occupants and will not impair health. It contains both a prescriptive and performance method for achieving acceptable indoor air quality. **ASHRAE 55-1981** THERMAL STANDARD is the primary standard for providing acceptable thermal conditions in the building and contains only a prescriptive standard.

Occupational Standards and Guidelines

The Occupational Safety and Health Administration (OSHA) regulates workplace exposure through the use of Permissible Exposure Limits (PELs).

The National Institute for Occupational Safety and Health (NIOSH) conducts health effects research and studies, and then makes recommendations to OSHA for new legislation or regulations. NIOSH sets recommended standards for incorporation into the OSHA regulations

The American Conference of Governmental Industrial Hygienists (ACGIH) annually publishes a list of Threshold Limit Values (TLVs). TLVs are to be used as guidelines for the control of potential health hazards in the workplace.

The American Industrial Hygiene Association (AIHA) has developed Workplace Environmental Exposure Limit (WEEL) guides for a number of chemical substances for which there are no legal or authoritative limits.

The National Academy of Sciences (NAS) Committee on Toxicology develops recommended exposure limits for narrowly defined occupational groups (military personnel). On at least one occasion, they have recommended an indoor air limit for military housing (the termiticide Chlordane was involved).

MANAGEMENT OF INDOOR AIR PROGRAMS

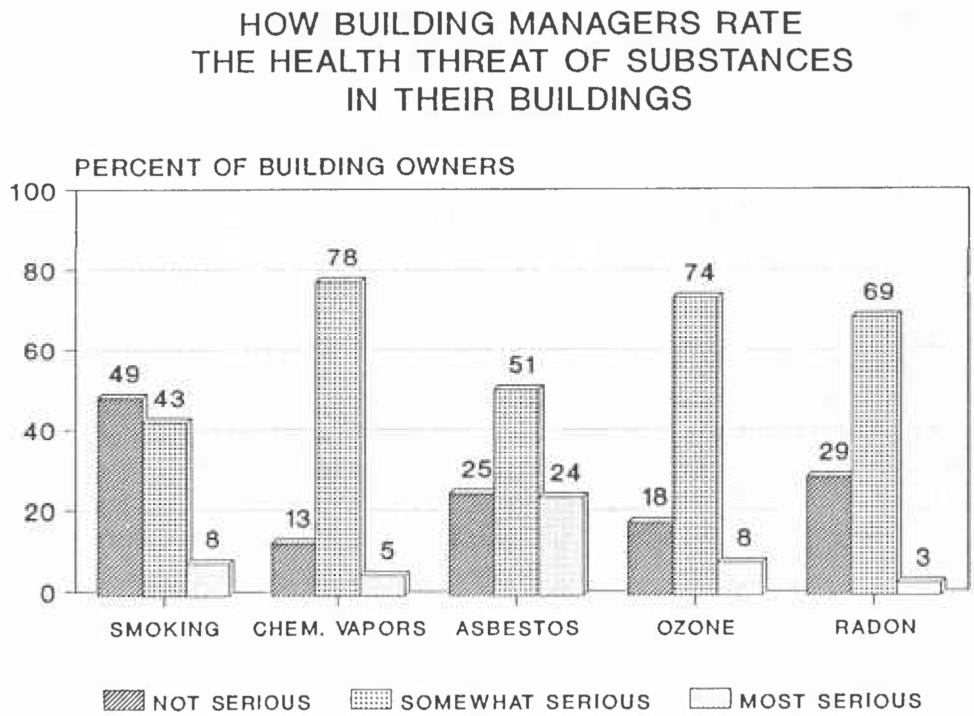
Building Managers Perception

In 1988, the Bureau of National Affairs, Inc. polled 100 building managers in four major U.S. cities - Atlanta, New York, Phoenix, and Chicago - on their understanding of, and attitudes toward indoor air pollution. Results indicate that one-third of the building managers view indoor air pollution as a "serious" health treat although almost none regard it a serious risk in their own building. The building managers ranked tobacco smoke as the top indoor air health risk problem. However, once again they do not generally regard it as a serious health problem in their own building.

Nearly half (43 percent) of the building managers said they had taken steps to improve their buildings' air quality in the past three years. The most frequent step taken was to change or install new air filters, followed by: increasing the intake of outdoor air, removing asbestos, instituting smoking restrictions, installing exhaust fans, monitoring the air quality, increasing filtration, and replacing or updating air conditioning systems or other equipment.

The building managers were asked to rate five substances as to how serious a health threat each substance poses to the buildings' occupants. **FIGURE 1-3** shows the majority of managers rated chemical vapors, asbestos, ozone, and radon as "not at all serious" problems in their buildings. Nearly half (49 percent) rated smoking fumes as "not at all serious", 43 percent rated smoking as "somewhat serious" in their buildings, and 8 percent rated it "very serious".

FIGURE 1-3



•Bureau of National Affairs, Inc./1988

Building Maintenance and Operations

Once a building has been constructed, responsibility for preserving good indoor air quality (IAQ) rests with the building operations and maintenance functions. Indoor air quality management plans need to be in place in all buildings starting with a survey to identify problem areas.

The major building components that should be evaluated include:

1. Roof
2. HVAC (to include local exhaust systems in specialty areas)
3. Humidification
4. Incineration
5. Plumbing
6. Electrical
7. Basement/crawl space
8. Other Areas:
   - Loading Docks
   - Food Services
   - Duplicating and Copy Rooms
   - Teacher Lounges
   - Gymnasiums-Pools
   - Laboratories
   - Storage Facilities
   - Art Areas
   - Theatre Crafts
   - Automotive Repair Shops
   - Industrial/Vocational Shops

Frequently Encountered Problems in Indoor Air Quality Surveys

1. Ventilation
   - Vents obstructed by furniture, partitions, etc.
   - Local exhaust improperly used/functioning
     - . Shop areas
     - . Arts and crafts
     - . Science labs
     - . Home economics
     - . Photo lab (acetic acid)
   - Loose fibrous glass insulation inside ductwork
   - Maintenance or repair of HVAC system
     - . Inadequate fresh air intake
     - . Improper air flows (check settings of dampers)
     - . Fans/blowers wired incorrectly
     - . Toxic solvents used to clean the system

. Inadequate air distribution

2. Volatile Organic Compounds
   - Paints
   - Cleaning fluids
   - Furniture stripping
   - Heating oil
   - Science lab
   - Auto repair (degreasers, cleaners, gasoline)

3. Fumes/Vapors
   - Welding
   - Auto, bus, truck exhaust

4. Thermal
   - High or low temperature
   - High or low humidity

5. Other
   - Formaldehyde
     . Plywood and pressed wood products
     . Carpet and glue
     . Draperies, furniture, etc.
   - Carbon monoxide
     . Boilers and furnaces
     . Motor vehicle exhaust
   - Particulates
     . Tobacco smoke
     . Diesel exhaust
   - Molds
     . In standing water
     . On wet or damp surfaces

Operational Manual

An operations manual including a systems description should describe how to run the building systems and the plan should provide a detailed step-by-step procedure covering operation from start-up to shutdown. This reference for day-to-day maintenance should be used to train new employees. A **vital part** of this plan should be a compilation of all available manufacturers literature and manuals.

The manual should cover the building system instrumentation that will gather information on physical plant system performance. It should list design criteria; performance criteria; acceptable ranges for fluctuations in gauges, meters, and recorders, and trouble shooting strategies. Information on the frequency of both routine and preventive maintenance should also be included. Most, if not all, of this information is readily available from the manufacturers.

Comprehensive Preventive Maintenance Plan

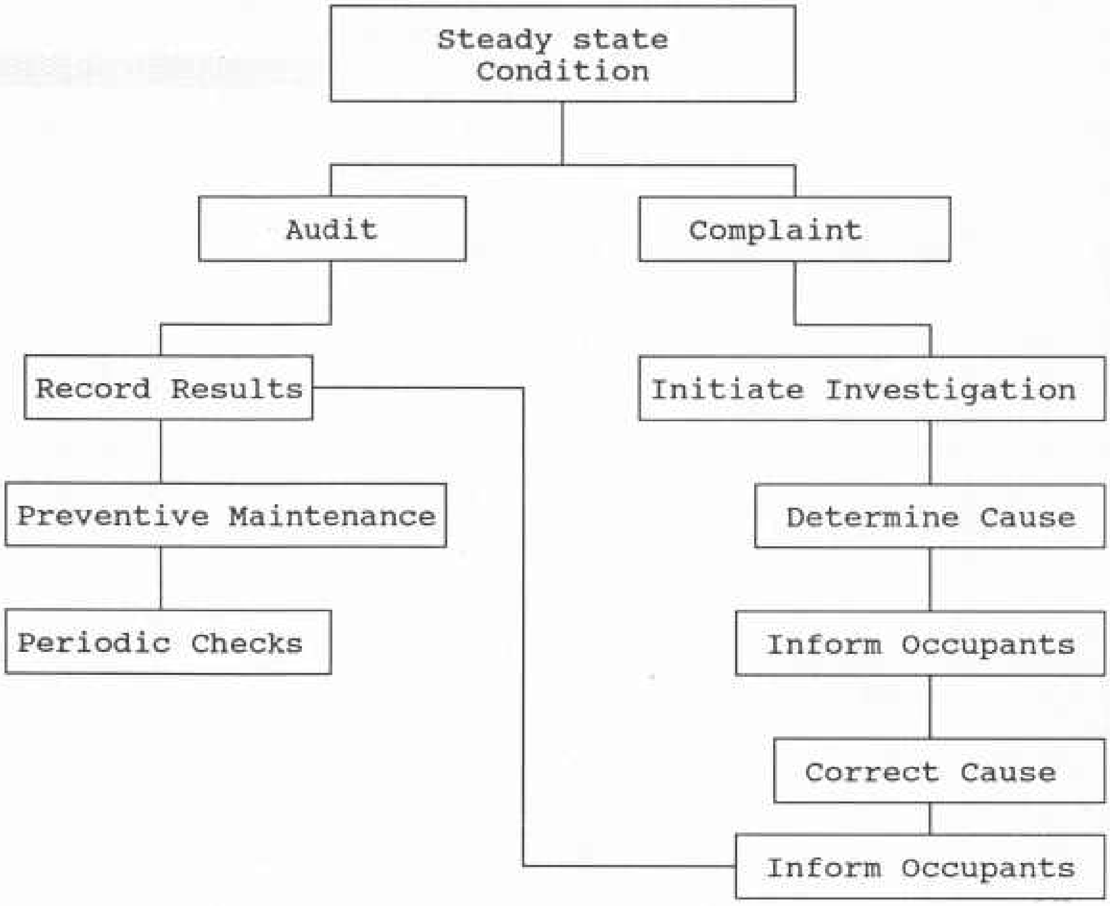
Preventive maintenance (PM) is an important component of a buildings IAQ program. This system provides, on a programmed frequency, PM cards informing the staff what is to be done on what piece of equipment in what time frame. The card is signed and dated by the person doing the PM as documentation that the work is being done on a timely and complete basis. This card is placed on file for future reference if required. The objective of preventative maintenance to prevent major costly outages or repairs. For example, regularly oiling a bearing on a fan system will extend the useful lifetime of the unit. Management should spot-check the tasks to see they are being done.

Scheduling periodic maintenance can be an important determinant of indoor air quality. Both the frequency and timing are important. For example, biological growth of fungi and bacterial organisms have often been found in a unit window ventilator with condensation pans. In some environmental studies, these organisms have been shown to cause disease. Since system unit ventilators run throughout the year, they will accumulate biological growth as the year progresses and may disseminate biologically active aerosols to the building's occupants all the time.

Preventive maintenance must be tied to a building's utilization schedule. Painting, coil cleaning, pest control or other projects involving the use of volatile organic chemicals should be scheduled when there are few, if any, occupants in the immediate vicinity. The work area should be well ventilated during and after this type of activity using fans wherever necessary.

IAQ management will not just happen. It requires leadership. The following overly simplistic chart depicts the flow of the IAQ management process.

Figure 1-4 Flow of IAQ Management



Providing feedback on complaints/investigations is essential and should not be limited to senior management. Particular attention should be paid to informing those initiating the complaint of the actions taken by management to resolve the problem.

PREVENTION AND REMEDIATION

There are six basic methods for lowering and preventing undesired concentrations of indoor contaminants.

1. **Ventilation** is a commonly used method for controlling indoor contaminants. Usually it is employed to both dilute the indoor air with outdoor air to exhaust polluted air. In buildings with mechanical ventilating systems, outdoor air is provided by design at rates specified in the applicable building codes. In other cases, local exhaust ventilation may be used to remove contamination at its source, such as in restrooms, studios, and laboratories.

2. **Filtration and purification** of indoor air are used where specific problems exist and practical devices are available. Particulate filtering is a highly advanced technology, but increased performance can involve significantly higher costs. Ordinary furnace filters are not fully effective in capturing pollen and other small particles. Higher performance filters are available at higher cost. Replacing filters more frequently during peak load times can increase the filtration efficiency. Pollen season or following fires in nearby buildings are examples of peak times.

Vapor and gas removal equipment is also available, but the technology for general use in ordinary buildings is not cost effective. Activated charcoal filters can be used to absorb high molecular weight molecules in varying efficiencies and holding capacities. Usually costs closely relate to their performance. However, it is difficult to determine when the filters are loaded, and they can give off lighter molecules previously absorbed. Potassium permanganate impregnated into porous alumina pellets (and other chemicals) can be used to oxidize or otherwise change particular gases and vapors into other, less hazardous or odorous forms.

3. **Removal or substitution of materials** that contribute to indoor air problems should be practiced whenever these materials can be identified and where satisfactory substitutes are available. Such materials include some paints and other finishes, manufactured wood products, plastics, cleaning and maintenance materials. A multitude of manufacturing processes may be used to lessen the outgassing of some undesirable materials.

4. **Encapsulation** with coating materials, or otherwise interfering with the materials ability to off gas pollutants, is another control method.

5. **The time of use** of a potential air contaminant is an important administrative strategy. The use of such materials should be timed when the least number of people will be exposed.

6. **Education** of building occupants is an important activity. If people are provided information about the sources and effects of contaminants, they can act to control their own indoor environment. More building users will minimize their indoor use of possible contaminants when they are provided an understanding of their relationship to indoor air quality.

ECONOMIC CONSEQUENCES

The potential economic impact of indoor air pollution is quite high, and is estimated in the tens of billions of dollars per year. Such impacts include direct medical costs and lost earnings due to illness, as well as increased employee sick days and lower productivity.

Labor costs may be 10 to 100 times greater per square foot of office space than energy and other environmental control costs. Thus, from a profit and loss standpoint, actions to improve indoor air quality where productivity is a concern are likely to be cost effective even if they require an expensive retro fit.

TYPES OF ECONOMIC COSTS

Three major types of economic costs are addressed in this chapter: (1) materials and equipment damages, (2) direct medical costs, and (3) lost productivity. These are defined as follows:

Materials and Equipment Damages

Indoor air pollution can soil indoor surfaces and can damage equipment and materials of various types. The costs of cleaning of cleaning, repair or premature replacement of equipment and materials are all part of this category of cost.

Direct Medical Costs

People whose health is affected by poor indoor air quality may incur costs for medical services. These costs include the costs of visits to the doctor or emergency room, hospital care, surgery, medication and the like.

Lost Productivity

Adverse health effects or general discomfort resulting from indoor air pollution may result in lost economic productivity. Lost productivity may occur on a continuum and include (1) lost productive years due to major illness, (2) lost time due to increased number of sick days taken from one's job, and (3) lost productive efficiency while on the job.

Estimates of productivity should include the effects on both income earning and non-income earning activities of value. Activities such as child care in the home, homemaking, and learning activities in a school or university setting should be included, although often they are not because they are difficult to quantify.

Costs not Considered

These three categories of costs--materials and equipment damages, direct medical costs, and lost productivity--represent only a part of the total economic losses due to indoor air pollution. Some economic costs not included in the above categories are:

- other welfare loss associated with pain and suffering due to health effects that are not fully alleviated by medical treatment;

- the value of unpaid time spent by persons taking care of those whose health is affected in the home; and

- losses due to reduced enjoyment of recreational and other non-productive activities affected by indoor air.

No attempt was made to estimate costs in these categories.

CHAPTER II

EXISTING REGULATIONS, STANDARDS AND PROGRAMS

People spend 85-90% of their lives indoors. Indoor air typically has more contaminants at higher concentrations than does outdoor air simply due to the containment of sources and their pollutants. To date, indoor air is comparatively unregulated. Several factors contribute to this apparent paradox.

1. Government reluctance to intrude into private homes.

2. About half of indoor air problems are due to inadequate ventilation combined with trace concentrations of pollutants. The investigation of indoor air problems is difficult since measurement of these trace pollutants is often expensive and complicated and standards either do not exist or are not protective of some segments of the population.

3. An impediment to using the regulatory approach is the difficulty in determining the sources of indoor air problems. A structure, its furnishings or its occupants' activities, or all three, can cause unacceptable indoor air quality. Modern fabrics, furnishings and building materials often emit trace contaminants which build up in airtight or inadequately ventilated spaces.

The correction of indoor air problems is often best achieved by a common sense approach, provisions of good ventilation and elimination of obvious sources. This is easier to achieve through cooperative efforts than through regulation except in the case of special occupational environments.

A. MARYLAND

1. Department of Licensing and Regulation

State regulation of air contaminants in the workplace, as well as other occupational safety and health requirements, is assigned to the Department of Licensing and Regulation's Maryland Occupational Safety and Health (MOSH) office. Its duty is to limit employees exposure to occupational hazards. Air contaminants found in commercial, office and institutional buildings, as well as residences, are usually at lower concentrations than the MOSH standards are designed to control. Adverse affects on health and comfort can exist for some individuals even when occupational standards are not exceeded.

MOSH enforcement activities for indoor air quality situations have been minimal. However, MOSH will accept requests through its employer consultation service. At the request of an employer's representative, a MOSH industrial hygienist will survey a facility and provide a written report offering recommendations to improve indoor air quality. At the same time, any violations of MOSH standards will be noted. Employers agree to correct violations in exchange for a free consultation visit.

In addition, MOSH has prepared "Guides for Evaluating Indoor Air Quality", a booklet designed to assist building owners or managers in conducting a self-evaluation of their property.

2. Maryland Department of the Environment (MDE)

The Maryland Department of the Environment provides investigative and consultative services to address indoor air quality problems in residential and public buildings. MDE's indoor air quality services extend to State and local government, business and private citizens. Charles, Cecil and Howard Counties' school systems and the Talbot County Courthouse are among those that have received assistance in solving specific indoor air quality problems. Public and private complaints are reviewed with emphasis on any reported health problem. As appropriate, MDE staff makes the appropriate contacts. If warranted, walk-throughs are used to spot any likely pollution sources. Existing air monitoring data are reviewed. If warranted, MDE may conduct an in-depth investigation of air quality.

The Department produces technical advisories and also helps distribute publications published by EPA and other environmental and health advocacies groups. MDE also maintains an indoor air quality reference library.

Outreach activities include prevention and remediation-oriented seminars to public and private groups promoting air quality.

Pursuant to Joint Resolution No. 32 of the Acts of 1988, the Department produced the report entitled "Chemical Hypersensitivity Syndrome Study" in March 1989.

Maryland's indoor air activities are non-regulatory. The following ongoing pollutant-specific State programs are aimed at minimizing exposure to radon, asbestos and lead paint:

a) Radon: Pursuant to Joint Resolution No. 11 of the Acts of 1987, the Maryland Radon Task Force, which was chaired by MDE, issued its findings and recommendations in a final report to the Governor on February 1989. In addition to publishing this report, MDE is involved in the following radon activities:

1. Cooperating with EPA in distributing the most current list of private radon testing firms that have voluntarily and successfully passed EPA's measurement proficiency tests; also providing a current list of mitigation companies that received appropriate training and have Maryland home improvement certificates.

2. Conducting occasional back-up radon monitoring of buildings whose owners wish confirmation of private test results showing high radon concentrations.

3. Giving technical guidance and assistance to local counties and municipalities who are planning to survey municipal and school buildings for radon.

4. Disseminating written information about radon and ways to reduce risks and maintaining a radon hotline.

b) Asbestos: This widely used insulation and decorative surfacing material has been of concern to Maryland since the early 1970's. As a regulatory requirement to address this concern, Maryland was the first state to license asbestos abatement contractors and require asbestos workers training. Nonregulatory asbestos programs within the MDE include providing asbestos-related, technical assistance and consultative services to the public and private sectors, State employee worker medical monitoring and training, and asbestos abatement contract specification development. Additionally, in 1987 MDE established the School Asbestos Assistance Division to assist all Maryland public and private elementary and secondary schools with complying with the extensive federal Asbestos Hazard Emergency Response Act (AHERA). Assistance includes reviewing the schools' asbestos management plans, conducting training seminars and workshops for school administrators, publishing newsletters, and providing on-site consultations.

MDE approves all asbestos-related worker training courses given by the private sector to ensure that adequate coverage of asbestos topics and correct information is conveyed to those responsible for asbestos management in buildings.

c) Lead: MDE is actively involved in the following lead activities:

1. Maintaining the Heavy Metals Poisoning Registry by recording abnormally high lead levels in adults and a childhood lead poisoning registry which tracks all testing of children for lead and its effects.

2. Overseeing enforcement regulations governing lead abatement methods. These regulations are considered a national model.

3. Promoting awareness of lead hazards and measures to reduce risk via the health education and public information program.

4. Conducting ongoing physician and provider education efforts to promote appropriate screening and testing of children and high risk adults and coordinating with Department of Health and Mental Hygiene who now provide and promote testing in local health department clinics and require increased screening for State-funded, well-child programs.

5. Focusing on post-abatement pilot projects in homes where children were poisoned. These small scale projects have been valuable in allowing testing of various abatement methods in developing of skilled abatement teams.

Current MDE research efforts in the lead area include:

1. Lead in Soil Project: A three year, EPA-funded $4.8 million project which targets two West Baltimore neighborhoods. This project will result in the abatement of exterior lead paint as well as soil from participating properties as well as testing of children before and after interventions. The purpose of this project is to assess the contribution of soil lead contamination from paint and gasoline to children lead levels.

2. Biomarkers for Lead Toxicity: A three year, Agency for Toxics Substances and Disease Registries (ATSDR) funded $1.9 million study of new methods of testing children for lead poisoning. This effort will develop practical, cheaper and less painful tests that can be incorporated.

3. Maryland State Department of Education (MSDE)

In 1986 indoor air quality was identified by the Maryland State Department of Education as an important public health concern. A State Committee on Indoor Air Quality in Public Schools was established in the spring of 1986 to develop a school facility guide for distribution to local school systems, local health departments, architects and engineers. The guide, Indoor Air Quality: Maryland Public Schools, was published in November 1987. The 41 page guide contains information on the definition and investigation of indoor air quality problems, building planning and design, and maintenance. The guide was used as the basis for two regional Maryland workshops in January 1988 for local board of education and health department staff. Many requests for the facility guide have been received from Marylanders as well as from most states, the District of Columbia and locations in Canada.

In May 1988 the Department selected one of several proposals submitted by local school systems to develop a model indoor air quality management program. With support from the U.S. Environmental Protection Agency (EPA) and the private sector, the model, Indoor Air Quality Management Program: Anne Arundel County Public Schools, was completed in March 1989. Using the model, the Departments' School Facilities Office has been meeting individually with public school systems to assist in the development of indoor air quality management programs.

The U.S. Environmental Protection Agency is presently developing an indoor air quality guide for schools. This document will be largely based on the above two Maryland documents as well as materials developed in Ontario, Canada.

In 1989 the Department was awarded a grant from the private sector to publish and distribute technical papers on indoor air quality in schools. These papers will address the design and maintenance of ventilation systems for several functional areas in schools. Distribution will be to all Maryland public school systems and local health departments, architects, other state departments of education and about 18,000 school systems in the United States. Also in 1989, EPA agreed to provide funding to the Department for training of Maryland local public school system staff as indoor air quality investigators and inspectors. This training is scheduled for May 1990. Indoor air quality measuring instruments (used at the training sessions and valued over $8,000) will be given to selected school systems.

B. FEDERAL GOVERNMENT

The **Environmental Protection Agency (EPA)** is the lead agency within the federal government for control of air pollution. The legal mandate for EPA's authority is derived primarily from the Clean Air Act that gives EPA responsibility for "ambient air," a term interpreted to mean that portion of the atmosphere external to buildings. The U.S. General Accounting Office (GAO) concurs with this interpretation, but has acknowledged that indoor air pollution has received little support precisely because no one federal agency has jurisdiction over nonindustrial indoor environments.

In addition to the Clean Air Act, the following other statutes are interpreted to allow the EPA to take action on indoor air quality:

(1) The Toxic Substances Control Act (TSCA) is aimed at controlling hazardous air pollutants. EPA has already used this statute to require asbestos management in schools and is currently considering the need for regulatory action to deal with the issue of formaldehyde exposures.

(2) The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) provides a mandate for the regulation of pesticides, including their application indoors.

(3) The Uranium Mill Tailings Radiation Control Act (UMTRCA) applies to uranium mill tailings, especially as they are used for landfills in residential areas or in the construction of dwellings. Because such uses could lead to elevated radon concentrations indoors, EPA has established guidelines for acceptable radon concentrations inside homes built in high risk areas.

(4) The Safe Drinking Water Act (SDWA) might also be used to deal with indoor radon problems in instances where drinking water is derived from radon-emitting substrata.

(5) The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or "Superfund" Authority could also be used to address certain indoor air quality problems because volatile organic compounds and radionuclides from hazardous waste sites can migrate through the soil and enter nearby buildings.

Beginning in fiscal year 1984, Congress appropriated funding for EPA to intensify its research efforts on indoor air quality. Overall, current funding for indoor air quality research constitutes about three percent of EPA's total air pollution research budget.

Besides EPA, a number of other federal agencies have responsibility for specific aspects of nonindustrial indoor air quality. The **Occupational Safety and Health Administration (OSHA)** is responsible for safeguarding workers' health in the workplace. Nevertheless, most OSHA activities have focused on industrial work environments, with relatively little attention given to problems in nonindustrial settings, such as building-related illnesses in office buildings.

The **Department of Energy (DOE)** is responsible for energy conservation programs that affect residencies and new buildings. DOE has funded studies to develop, evaluate, and standardize measurement techniques, as well as research to examine human health effects from organic vapors, airborne particles, and radon. **The Bonneville Power Administration (BPA)** in Oregon is currently financing a project to measure a variety of indoor pollutants inside both new and existing buildings within its service area and to determine the impact of weatherization measures on indoor air quality. Ensuring that consumer products are safe and do not present unreasonably health risks is the responsibility of the **Consumer Product Safety**

Commission (CPSC). CPSC has banned the use of asbestos-containing spackling compounds, proposed a ban of urea-formaldehyde foam insulation (overturned in court), and initiated studies of emissions from unvented combustion appliances, including kerosene heaters and gas-fired space heaters.

The Department of Housing and Urban Development (HUD) establishes building standards for HUD-funded projects and material standards for mobile home construction. HUD has required that indoor radon concentrations in high natural radium areas of Montana and South Dakota be below established minimums before home buyers qualify for HUD-assisted financing. HUD refused to approve FHA-financed loans for new home construction on reclaimed phosphate lands in Florida, due to possibility of elevated indoor radon levels. HUD recently promulgated regulations specifying formaldehyde-emission limitations for plywood and particle-board products.

The **Federal Trade Commission (FTC)** is responsible for ensuring that consumer advertising contains accurate, truthful, and useful information. The FTC recently charged two manufacturers of room air cleaners with falsely advertising that their devices effectively remove tobacco smoke and other pollutants from indoor air. In reaching consent agreements with the FTC, both companies agreed not to misrepresent the capabilities of their air cleaners.

During 1983 the Congressionally-mandated interagency **Committee on Indoor Air Quality (CIAQ)** was established to coordinate federal research activities. Representatives from EPA, DOE, the Department of Health and Human Services (DHHS), and CPSC serve as co-chairs. Among the other federal agencies involved in the CIAQ are BPA, the Department of Defense, FTC, the General Services Administration (GSA), the National Bureau of Space Administrations, the National Bureau of Standards, OSHA, the Tennessee Valley Authority, and the Department of Transportation. The CIAQ is presently compiling an inventory of federal indoor air research to identify needed research by both the public and private sectors.

The **U.S. Department of Health and Human Services' National Institute for Occupational Safety and Health (NIOSH)** published "INDOOR AIR QUALITY Selected References" in September 1989 based on NIOSH's experience in conducting approximately 450 field investigations of indoor air quality problems in many types of buildings. NIOSH guidance from this publication is presented in three sections including (1) <u>NIOSH's experience</u> which provides the reader with information regarding our experience with indoor air quality problems and describes some of the most common causes of these problems, (2) Self evaluation of indoor air quality problems which describes a "self help" approach to assist the reader in evaluating an indoor air quality problem, and (3) Indoor air quality consultation services where the reader can go, in addition to NIOSH, for assistance if self-evaluation cannot resolve the problem.

A listing of federal, state and public contacts is listed as Appendix H.

C. LOCAL PROGRAMS AND CODES

The 1987 Building Owners and Contractors Association (BOCA) Mechanical Code is in effect in most jurisdictions in Maryland. Local health and environment departments in some counties have staff to investigate complaints about indoor air pollution. Several counties have active indoor air quality programs that provide investigative and consultative services. Many Maryland public school systems have redefined or created new positions to solely deal with environmental issues including indoor air quality.

D. PROFESSIONAL ORGANIZATIONS

1. ASHRAE: American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) recommendations address three factors with respect to buildings; i.e., design, construction and operation. In 1973 ASHRAE prescribed (Standard 62-1973) a minimum of 5 cubic feet of fresh air per occupant to keep carbon dioxide levels below one half the industrial limits (of 5,000 parts per million), but recommended up to 50 cfm per occupant in minimizing odors. The 1975 the energy crises prompted ASHRAE to subsequently adopt Standard 90-75, further decreasing ventilation rates for many applications to near the minimum of five cubic feet per minute per occupant. This minimum ventilation rate frequently proved inadequate to prevent an unacceptable build up of bioeffluents or tobacco smoke. Consequently, in 1981 a later revision, ASHRAE Standard 62-1981, recommended between 15 and 50 cubic feet per minute per occupant in areas of buildings where smoking is permitted. After seven years in development, ASHRAE Standard 62-1989 is pending adoption by model building codes organizations such as BOCA. It recommends a minimum of 15 cubic feet per minute per occupant and more stringent rates for specific situations; e.g., 25 cubic feet per minute in hospital patient rooms. These most recent standards are

intended to assure "acceptable indoor air quality", defined by ASHRAE as "air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.

Occupants' ratings of indoor air quality are influenced by air temperature, humidity and worked and worked-related stress, making subjective response hard to relate to specific pollutant concentrations. In office settings, carbon dioxide in excess of 1000 ppm, carbon monoxide above 2 ppm, or volatile organic compounds at more than 1.0 to 2.5 micrograms per cubic meter are indicative of the presence of odorous or irritation contaminants at levels that are likely to provoke "unacceptable" ratings by more than 20% of occupants.

Building age and occupancy patterns strongly influence the adequacy of ventilation rates. Building finishes and furnishings outgas at rates that decrease exponentially with time. Therefore, outgassing rates and pollutant partial pressures are strongest when a building is new. Regulations in some European countries require new buildings to remain unoccupied until outgassing rates fall to acceptable levels.

The fiscal impact in Maryland for providing or retrofitting proper ventilation for office buildings is in the range of a few percent. Typically, office building refrigeration capacity must be increased in the order of 5% (a capital cost). For other applications such as school classrooms and auditoriums, the impact upon costs and energy use is likely to be greater. Energy conservation measures to offset these increases may be economically justifiable.

CHAPTER III

RECOMMENDATIONS

We know that pollutant concentrations can often be much higher indoors than outdoors. We also recognize that people spend significantly more time indoors than outdoors. For these reasons, risk to human health from indoor air contaminants is potentially greater than the risk from outdoor air. Indoor air quality is among the Nation's most important environmental health considerations.

A proactive posture is deemed more cost effective than wide scale monitoring of indoor air quality. Four considerations make up the primary framework for effectively decreasing indoor air quality problems. These include (1) design standards for new construction and major renovations; (2) maintenance and operations procedures that address indoor air quality; (3) periodic inspections of buildings, and (4) education and training programs.

The recommendations are divided into five categories: (l) Maryland Schools, (2) Education/Outreach and Training, (3) Design, Construction and Renovation, (4) Facilities Operations and Maintenance, and (5) The State as a Role Model. Since a great deal of practical experience has been gained from indoor air quality programs developed for Maryland public elementary and secondary schools, the Task Force singled out the schools as a category and based many of its recommendations on making this experience available to other sectors. The Task Force further proposes that Maryland can become a role model by creating an indoor air program in State-operated facilities. The Task Force recognizes that some of these recommendations can be implemented immediately while others require a longer implementation period.

MARYLAND SCHOOLS

Recommendations

I. In order to adequately address indoor air quality concerns, school systems should develop a comprehensive indoor air quality management program at the earliest possible date. This program should include the following components:

A. Design standards for all new construction and major renovations to existing buildings.

B. A preventive maintenance program that specifically addresses indoor air quality issues.

C. Training programs for all board of education staff but particularly maintenance, operations, planning and design staff.

D. A systematic survey of all school buildings with reinspections occurring on the average of every three years.

E. A voluntary identification program of medically documented, asthmatic or otherwise highly sensitive students and staff to allow for reasonable accommodation for these individuals.

F. A policy to restrict tobacco smoking by students and staff to be implemented consistently throughout each school system.

G. An investigation procedure to respond to complaints from building occupants.

H. A system of recordkeeping.

II. The Maryland State Department of Education should provide broader distribution of the documents entitled "Indoor Air Quality: Maryland Public Schools" and the subsequent systems approach workbook "Indoor Air Quality Management Program/Anne Arundel County Public Schools" to include private elementary and secondary schools. Provide additional seminars and teaching activities to accompany these documents. The Department should continue and expand its role as the central liaison to public and private elementary and secondary schools.

III. The Maryland State Board of Education should regulate the operation, maintenance, inspection and recordkeeping of heating, ventilating and air conditioning (HVAC) systems in public elementary and secondary school buildings.

IV. The Maryland State Department of Education should develop and disseminate technical papers on various aspects of indoor air quality in public and private schools.

V. The Maryland State Department of Education should continue to provide and expand indoor air quality outreach programs to public and private school organizations, such as Parent/Teacher Associations.

VI. The Maryland State Department of Education should continue to review locally funded school construction projects for indoor air quality design factors, and the Departments of General Services and Education sections of the Interagency Committee for School Construction should continue to review State-funded projects for indoor air quality design factors.

VII. The Maryland State Department of Education should promote the use of integrated pest management programs for public and private elementary and secondary schools and in vocational and higher education facilities. The Montgomery County school system has implemented this policy and has proven it to be both cost effective and well supported by staff and parent groups. **(SEE APPENDIX I.)**

EDUCATION/OUTREACH AND TRAINING

Enhanced public awareness helps people deal with indoor air quality. The State should concentrate on outreach, educational and awareness actions rather than to regulatory programs. This expanded awareness effort should be led by the Maryland Department of the Environment in cooperation with other State agencies including, but not limited to, the Maryland Departments of Education, Licensing and Regulation, Health and Mental Hygiene, and General Services.

Recommendations - Education/Outreach

I. The State should educate the public for the purpose of improving indoor air quality e.g., using least toxic products, having adequate ventilation, obtaining safe indoor heating devices, and regularly changing filters and servicing heating, ventilation, and air conditioning systems according to manufacturer or installer instructions.

II. The State should publicize the benefits of properly maintained ventilation systems (improved ventilation systems can ameliorate over 50% of indoor air quality problems).

III. The State should distribute a list of common conditions leading to indoor air quality problems and techniques that can be used to avoid or minimize these problems.

IV. The State should conduct outreach aimed at educating the public on how effective communication between building occupants and managers can help remediate indoor air quality problems.

V. The State should provide information to architects, interior designers, builders, contractors, and consumers on how to reduce the use of products which emit volatile compounds or elements which threaten health.

VI. The State should facilitate technology transfer of indoor air management information from federally-funded research and development programs to local governments, commercial and residential property owners, consumer interest groups, schools and the general public.

VII. The State should seek federal grants to do pilot and demonstration projects on how to improve indoor air quality but should not attempt to undertake major research projects.

VIII. The State should promote a policy of using integrated pest management systems in public buildings. This is consistent with an approach of prudent use of pesticides and has been proven cost effective in its application by the Montgomery County school system. **(SEE APPENDIX I.)**

IX. The Maryland Department of the Environment should be designated as the central resource for indoor air quality for local authorities and the public.

Recommendations - Training

I. Community colleges and continuing education programs in collaboration with the Maryland Departments of the Environment and Education should develop effective training packages leading to voluntary certification programs for indoor air quality management for building engineers and maintenance supervisors. The curriculum should include such topics as testing and calibration of automated controls, frequency of system cleaning and filter replacement, cooling water decontamination, dealing with water damage and dampness, recognizing dead air zones, and testing for blocked or disconnected air vents.

II. The Maryland Departments of the Environment and Education should continue to hold training programs for schools and develop similar programs for managers of other buildings. The curriculum should enable managers to prevent and recognize problems and to seek help from reliable sources.

III. The Maryland Department of the Environment should train local environmental and health personnel so that they are able to provide indoor air quality assessments and make knowledgeable responses to indoor air quality inquiries.

DESIGN, CONSTRUCTION AND RENOVATION

Planning for indoor air management in the design, construction and renovation of buildings can prevent indoor air quality problems. This is more cost effective than retrofitting buildings.

Recommendations

I. The State should promote Statewide adoption of building codes which include the new American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 62-1989 - Ventilation for Acceptable Indoor Air Quality. To obtain a copy of the ASHRAE Standard, write to:

American Society of Heating, Refrigeration
and Air Conditioning Engineers
1791 Tullie Circle, N.E.
Atlanta, Georgia 30329

II. Pending action on the new ASHRAE Standard by Building Owners and Contractors Association (BOCA), the State should encourage building designers to follow the new ASHRAE Standard 62-1989.

III. The State should develop design standards using as a guideline the standards outlined in the document entitled "Indoor Air Quality Management Program - Anne Arundel County Public Schools." **(SEE APPENDIX F.)**

IV. The State should support licensing procedures for heating, ventilation, air conditioning and refrigeration contractors.

FACILITY OPERATIONS AND MAINTENANCE PROCEDURES

Once a building has been constructed, the operation and maintenance functions are the single most important factors to maintaining good indoor air quality. The State recommends a comprehensive facilities management program be established. **(SEE APPENDIX G WHICH CAN USED AS A GUIDE.)** All building managers should establish such a program to properly manage scheduled maintenance, repairs, minor alterations to facilities, as well as guide the reaction to unscheduled breakdowns.

To implement a maintenance/operations program, three elements must be provided: (l) management support and commitment, (2) trained personnel, and (3) adequate funds.

THE STATE AS A ROLE MODEL

The following recommendations are areas where Maryland can act as a role model in developing a standard indoor air quality program for facilities owned or leased by the State.

Recommendations

I. The Department of General Services should work with the Departments of the Environment, Licensing and Regulation, Education, Personnel and the Office of the Attorney General and other State agencies that control facilities to develop and implement indoor air quality management programs. The management program should be similar to that outlined under the **MARYLAND SCHOOLS** section of this Chapter and include a trained coordinator at each facility.

II. The Department of General Services should work with the Departments of the Environment, Licensing and Regulation, Education, Personnel and the Office of the Attorney General and other state agencies that manage facilities to adopt an integrate pest management policy for both indoors and out. This system requires monitoring, record keeping, determination of pest population size and using the least amount of chemicals possible to control pest populations at acceptable levels. Indoor air coordinators in state facilities should receive specific training in the implementation of this policy.

III. The Department of General Services should work with the Departments of the Environment, Licensing and Regulation, and Education to establish procedures that address indoor air quality for the maintenance and operation, inspection and recordkeeping of HVAC systems in buildings under State authority.

IV. The Department of Personnel should work with the Departments of Environment and Licensing and Regulation to modify existing State personnel policies to permit employee release time during a significant indoor air quality emergency:

> (A) at the discretion of the Department heads when time does not permit consultation with others, and
>
> (B) in circumstances other than in (A) above, in consultation with the Department of the Environment and Department of Personnel.

V. The Department of General Services should continue to review designs for State construction projects for indoor air quality factors and construction funded by the State should be designed to prevent indoor air quality problems.

VI. State Use Industries should manufacture and store furniture in ways to minimize long term offgassing of volatile organic compounds (VOCs).

VII. Establish a Governor's Indoor Air Quality Oversight Committee for the purpose of monitoring and coordinating these recommendations and reporting to the Governor on additional steps that need to be taken.

APPENDIX A

INDOOR QUALITY TASK FORCE
BIOGRAPHIES OF MEMBERS

KATHERINE P. FARRELL, M.D., M.P.H. - National University of Ireland, M.D., 1972 where she served residencies in internal medicine and public health. Currently, Dr. Farrell is the Assistant Secretary for Toxics, Environmental Science and Health in the Maryland Department of the Environment. Prior to becoming Assistant Secretary, she held various positions in Maryland's environmental programs, first within the Department of Health and Mental Hygiene and later in the newly created Maryland Department of the Environment. Dr. Farrell has served on a wide variety of special task forces, boards and councils, and has publications on a variety of environmental health topics. Currently, Dr. Farrell is Principal Investigator of a five million dollar study of lead-in-soil going on in Baltimore and serves as the Chair of the Governor's Task Force on Indoor Air Quality.

BARBARA A. HOFFMAN - The Johns Hopkins University, M.L.A., 1966. Supervisor of secondary school teachers, Morgan State University, 1963-73. Executive Director, Maryland Democratic Party, 1979-83. Served on boards of various civic and philanthropic organizations. 2nd Vice President, National Association of Jewish Legislators. Past president, Hadassah, and Maryland Committee for Children, Inc. Co-author, Journeys in English, an English textbook. Member of Senate since 1983. Deputy Majority Whip. Member, Budget and Taxation Committee; Joint Committee on Administrative, Executive and Legislative Review (AELR); Joint Budget and Audit Committee; Joint Committee on Pensions; Executive Nominations Committee. Member, Commission on Aging.

DONALD B. ELLIOTT - University of Maryland School of Pharmacy, B.S., 1957. Served in the U.S. Navy; Corpsman 2nd class, Navy Hospital Corps, 1951-55; Lieutenant, 1959-63; Naval Reserve, 1963-71; presently LCDR (retired). Member, New Windsor Planning Board, one year; New Windsor Zoning Appeals Board, five years. Member of the House of Delegates since 1987. Member, Environmental Matters Committee.

TONY EDWARD FULTON - University of Maryland, M.A., 1975. Served as legislative staff, 1975-79. Lobbyist for eight years. Former staff to Governor's Task Force on Hazardous Waste Initiatives. Member, Board of Directors, Park West Health Center. Past member, Executive Committee, Baltimore League of Women Voters. Member, Prince Hall Mason; Kappa Alpha Psi Fraternity. Listed in Who's Who in American Colleges and Universities. Member of the House of Delegates since 1987. Member, Environmental Matters Committee.

ALLEN C. ABEND - Teachers College, Columbia University, M.A. (Educational Administration), 1972; "Indoor Air Quality Diagnostics" - a 4 1/2 day professional training course conducted by Honeywell, Inc., 1988. A licensed architect and currently Chief, School Facilities Office, Maryland Department of Education. Co-author of "Indoor Air Quality: Maryland Public Schools", 1987. Coordinator and speaker for Indoor Air Quality Public Schools Workshop, Columbia and Salisbury, Maryland, 1988. Grant Administrator, Model Indoor Air Quality Management Program, 1988-89. Member, Association of School Business Officials (MD/D.C.) and Board of Directors, Maryland State School Health Council.

ALVIN BOBER - New York University, M.S. (Chemistry), 1948. Presently, he is the Chief of the Environmental Chemistry Laboratory for the State of Maryland. Mr. Bober was one of the original organizers of the Society for Applied Spectroscopy (SAS). In addition to his work in SAS, Mr. Bober has a history of service with the American Chemical Society, the Middle Atlantic Association of Forensic Scientists, the Association of Official Analytical Chemists, and the Eastern Analytical Symposium. Mr. Bober has been an active worker in applied spectroscopy, analytical chemistry, and microchemical procedures.

MAX EISENBERG, Ph.D. - Northeastern University, Ph.D., (Inorganic chemistry), 1971. Dr. Eisenberg is currently Director of the Center for Indoor Air Research. This organization is a non-profit corporation which provides funding for research in the area of indoor air quality. He also holds adjunct positions with the Chemistry Department at Towson State University and the Department of Epidemiology and Preventive Medicine at the University of Maryland School of Medicine. Prior to his selection as Executive Director, he was the Assistant Secretary for Toxics, Environmental Science and Health for the Maryland Department of the Environment from 1987 to 1988. He served as Director of the Science and Health Advisory Group with the Department of Health and Mental Hygiene from 1980 to 1987. Dr. Eisenberg serves on a number of national and international advisory committees as well as holding membership in professional and honorary societies. He has published extensively in the scientific literature in the fields of chemistry and public health.

ALLAN B. HEAVER - Mr. Heaver is the Managing General Partner of the Heaver Properties. He has over 17 years with this firm which has been involved in the management and development of commercial real estate for over 30 years. Additionally, Mr. Heaver is currently serving his third term as the President of the Building Owners and Managers Association of Baltimore (BOMA). He serves on BOMA International's Board of Governors and is a Director of their Mid Atlantic Region. Mr. Heaver has been associated with Wyman Park Federal Savings and Loan for the past eight years and currently serves as the Chairman of the Board. He also served on Lung Association of Maryland, Indoor Air Committee and on the Integrated Environmental Management Project Study Group for Indoor Air.

JEFFERSON D. HERRING - Tuskegee University, 1968. Mr. Herring has worked in the chemical industry as a controls engineer, technical service representative, a development chemist, sales engineer, sales manager, and sales and marketing product manager. Mr. Jefferson is a co-author of technical papers which have been published in the C&E News on fire retardants and resins, as well as commercial articles associated with the **RANEY** product lines which he now manages. He is listed in Who's Who in World Petrochemicals, 3rd and 4th editions. More recently, Mr. Jefferson has served as Manager of Emission Control, Polyolefin, RANEY Nickel and Custom Catalyst business. He is currently Sales and Marketing Manager of Other Industrial Catalysts, which services the heavy industrial chemicals and pharmaceutical industries. Member, various Greater Baltimore subcommittees, Junior Achievement, Vice President of the Baltimore Tuskegee Alumni, and was recently appointed board member of the Baltimore Goodwill Industries.

THOMAS E. HOBBINS, M.D. - Hahnemann Medical College, M.D., 1964. He is specialist in internal medicine, pulmonary diseases and sleep disorders medicine. A Clinical Associate Professor of Medicine of the University of Maryland School of Medicine, Dr. Hobbins is active as a medical educator. He is President of Baltimore Physicians for Social Responsibility, a volunteer and former officer of the American Lung Association of Maryland, and a member of the Human Rights Committee of the Veterans Administration Cooperative Studies Program Coordinating Center.

WILLIAM HUBALEK - Furman University, B.A., 1960. Currently, District Appraiser with the Office of Thrift Supervision, Department of the Treasury. Instructor, Environmental Hazards: Implications for Real Estate, George Washington University. Member, American Institution of Real Estate Appraisers; Washington, D.C. Association of Realtors, Inc.; Charter member, National Association of Review Appraisers.

HENRY KRAMER - Columbia University, B.S. (Civil Engineering), 1953. A Registered Professional Engineer with 34 years experience in construction, Mr. Kramer joined the George Hyman Construction Company in 1971 as a Project Supervisor responsible for directing the construction operations on the Metro Control Center Building. He was then promoted to General Superintendent assuming the primary responsibility for directing and controlling preconstruction and construction activities on many of the company's more complex projects. From General Superintendent, he moved on to Project Executive responsible for numerous projects including the 775,000 SF award-winning Willard Hotel/Office and the 850,000 SF Columbia Square projects, both in Washington, D.C. In 1974, Mr. Kramer was promoted to Vice President and in 1985, he was became Senior Vice President.

RONALD D. LeCLAIR - Springfield College, B.A. (Biology), 1966. Chief of Maryland Occupational Safety and Health's Public Sector Consultation Unit. Formerly, a sanitarian with Baltimore City Health Department. Member, Governor's Council on Toxics Substances. Past President of Maryland Public Employee's Association. Member of American Conference of Governmental Industrial Hygienists, American Industrial Hygiene Association, and American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).

JAMES MILLER - Frostburg State College, Certified in Management Science, 1980. Mr. Miller, President, James W. Miller, Inc., a general contracting/construction management company and former Vice-President of Thomas P. Hawkins, Inc., also a construction company. He has held various positions with Harkins since joining the company in 1972. Mr. Miller is a member of the Construction Management Association of America, Associated Builders and Contractors (Metropolitan Washington), and the Home Builders Association (Baltimore Chapter) where he was President in 1986-87 and Vice President in 1985-86.

ARTHUR E. WHEELER - Duke University, B.S. (Mechanical Engineering), 1947. A registered Professional Engineer with over 40 years experience in the design of building refrigerating and air conditioning systems, he is an ASHRAE Fellow, recipient of the Society's Distinguished Service Award and has served on many of its standing committees including the Technical Committee for Large Building Air Conditioning Systems, Standard Projects Committees for Energy Conservation 90-75 and 90A-1980; and the Indoor Air Quality Standard, 62-1989. Author of numerous papers and lecturer on Indoor Air Quality. Mr. Wheeler is currently President of the Wheeler Engineering Company in Towson, Maryland.

APPENDIX B

GLOSSARY

Acceptable air quality: Air in which there is no known contaminants at harmful concentrations and with which a substantial majority (usually 80%) of the people exposed do not express dissatisfaction.

Acceptable thermal environment: An environment which at least 80% of the occupants would find thermally acceptable.

Acid aerosol: Acidic liquid or solid particle that are small enough to become airborne. High concentrations of acid aerosols can be irritating to the lungs and have been associated with some respiratory diseases, such as asthma.

Aerosol: A gaseous medium containing suspended particles.

Air, ambient: The air surrounding an object.

Air, cleaner: A device designed to remove airborne impurities such as dusts, gases, vapors, fumes, and smokes.

Air conditioning: The process of treating air so as to control simultaneously its temperature, humidity, cleanliness, and distribution to meet requirements of the conditioned space.

Air, exchange: The mixing or dilution of indoor air with outdoor air through natural ventilation, mechanical ventilation, or through infiltration and exfiltration.

Air, exhaust: Air removed from a space and not reused therein.

Air, makeup: Outdoor air supplied to replace exhaust air and exfiltration.

Air, outdoor: Air taken from the external atmosphere and therefore, not previously circulated through the system.

Air, recirculated: Air removed from the conditioned space and reused as supply air.

Air, supply: That air delivered to a space and used for ventilation, heating, cooling, humidification, or dehumidification.

Air, ventilation: That portion of supply air which is outdoor air plus any recirculated air that has been treated for the purpose of maintaining acceptable indoor air quality.

Allergen: A substance capable of causing an allergic reaction because of an individual's sensitivity to that substance.

Allergic rhinitis: Inflammation of the mucous membranes in the nose.

Animal dander: Tiny scales of animal skin.

ANSI: The American National Standards Institute is a voluntary membership organization (run with private funding) that develops consensus standards nationally for a wide variety of devices and procedures.

Asbestos: The name given to a naturally occurring group of minerals composed of tiny, easily inhaled fibers. In the home, public and commercial buildings and schools, the more commonly used application include: heat and acoustic insulation, fireproofing, roofing and flooring materials.

ASHRAE: The American Society of Heating, Refrigeration and Air Conditioning Engineers.

Bioaerosols: Biological agents which include bacteria, fungi, pollen, animal dander, cat saliva, and molds. They are usually inhaled, either alone or by attaching themselves to particles of dust and then entering the respiratory system.

BOCA: Building Officials and Code Administrators, International.

Breathing zone: The area of a room in which occupants breathe as they stand, sit, or lie down.

Building complaint investigations: Attempt to determine and remedy the source of building health complaints sometimes referred to as "sick building syndrome." Factors include an examination of the ventilation system, chemical and biological pollutants, building materials and furnishings, thermal conditions such as temperature and humidity, and a record of occupant health complaints.

Building-related illness: Term that refers to a discrete, identifiable disease. Can be traced to a specific pollutant or source within a building. (Contrast with "Sick building syndrome.")

Carcinogen: A substance that can cause the growth of cancer.

Chemical Sensitivity: Evidence suggests that some people can develop health problems characterized by effects such as dizziness, eye and throat irritation, chest tightness, and nasal congestion that appear whenever they are exposed to certain chemicals. People may react to even trace amounts of chemicals to which they have become "sensitized.

Combustion devices: Include unvented kerosene and gas space heaters, wood stoves, fireplaces and gas stoves.

Combustion gases: Include both particulate and gases such as carbon monoxide, carbon dioxide, oxides of nitrogen, sulfur oxides, polycyclic aromatic hydrocarbons, hydrocarbons, automobile exhaust, and gasoline and diesel fumes.

Contaminant: An unwanted airborne constituent that may reduce acceptability of the air.

Dust: An air suspension (aerosol) of particles of any solid material, usually with a particle size less than 100 micrometers (um).

Environmental Tobacco Smoke (ETS): ETS is one of the most widespread and harmful indoor air pollutants. ETS comes from secondhand smokers and sidestream smoke emitted from the burning ends of cigarettes, cigars, and pipes. ETS is a mixture of irritating gases and carcinogenic tar particles. It is known to cause lung cancer and respiratory symptoms and has been linked to heart disease. Breathing in ETS is also known as "involuntary" or "passive" smoking.

Epidemiology: The field of science that concerns itself with the determinants of disease in populations and with the factors that influence its distribution.

Fungi: Any of a group of parasitic lower plants that lacks chlorophyll, including molds and mildews.

HEPA filter: (High Efficiency Particulate Air Filter) A disposable, extended medium, dry type filter with a particle removal efficiency of no less than 99.97 percent for 0.3u particles.

Humidifier fever: A respiratory illness that may be caused by exposure to toxins from microorganisms found in wet or moist areas in humidifiers and air conditioners. Also called air conditioner or ventilation fever. (see also hypersensitivity pneumonitis)

HVAC: Heating, ventilation, and air conditioning. A system concerned with the temperature, humidity, cleanliness and distribution of air.

Hypersensitivity: An altered state or activity in an individual following contact with certain kinds of substances (inanimate or animate).

Hypersensitivity pneumonitis: A group of respiratory diseases, including humidifier fever, that involve inflammation of the lungs. Most forms of hypersensitivity pneumonitis are thought to be caused by an allergic reaction triggered by repeated exposures to biological contaminants. Humidifier fever may be an exception, distinguished from other forms of pneumonitis by the fact that it does not appear to involve an allergic reaction.

Indoor Climate: Variables, such as, air temperature, radiant heat, humidity, and air movement, that cause relative degrees of human comfort or discomfort.

Indoor air quality: The nature of air that affects the health and well-being of occupants.

Industrial Hygiene: That science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.

Industrial Hygienist: A person who practices industrial hygiene.

Legionnaires' Disease: An acute bacterial pneumonia caused by infection with Legionella pneumophila and characterized by an influenza-like illness followed within 1 week by high fever, chills, muscle ache, and headache. Symptoms may include dry cough, inflammation of the membrane covering the lungs (pleurisy), and sometimes diarrhea.

Malaise: A vague feeling of body discomfort.

Mildew: A plant disease inwhich a fungus forms a superficial growth on a plant, usually under damp conditions.

Mold: A fungus growth ofter produced by the breakdown of organic matter. The common molds include Penicillium, Rhizopus, or Aspergillus.

Natural Ventilation: The movement of air into and out of a space through intentionally provided openings, such as windows and doors, or through nonpowered ventilators or by infiltration.

Organic compounds: Chemicals that contain carbon. Volatile organic compounds vaporize at room temperature and pressure. They are found in many indoor sources, including many household products and building materials.

Pathogenic: Having the ability to produce or cause a disease. Usually denotes inability to cause infection rather than allergy.

Permissible exposure limit (PEL): An exposure limit that is published and enforced by OSHA as a legal standard.

Pesticides: General term for that group of chemicals used to control or kill such pests as rats, insects, fungi, bacteria, weeds, etc., that prey on man or agricultural products. Among these are insecticides, herbicides, fungicides, rodenticides, miticides, fumigants, and repellents.

Picocurie: A unit for measuring radioactivity, often expressed as picocuries per liter of air.

Plenum chamber: An air compartment connected to one or more ducts or connected to a slot in a hood used for air distribution.

Polycyclic aromatic hydrocarbons: A group of organic compounds. Some are known to be potent human carcinogens.

Pressed wood products: A group of materials used in building and furniture construction that are made from wood veneers, particles, or fibers bonded together with an adhesive under heat and pressure.

Radon and radon decay products: Radon is a radioactive gas formed in the decay of uranium. The radon decay products (also called radon daughters or progeny) are particles that can be breathed into the lung where they continue to release radiation as they further decay.

Sensitizer: A material that can cause an allergic reaction.

Sick building syndrome: Term that refers to a set of symptoms that affect a number of building occupants during the time they spend in the building and diminish or go away when they leave the building. Cannot be traced to specific pollutants or sources within a building. (Contrast with "Building-related illness".)

Thermal comfort: That condition of mind which expresses satisfaction with the thermal environment

Threshold limit values (TLV's): Exposure guidelines established by the American Conference of Governmental Industrial Hygienist (ACGIH) for airborne concentrations of substances and believed to represent conditions which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Toxicity: The degree to which a chemical agent produces a harmful effect on some biologic mechanism.

Ventilation: The process of supplying and removing air by natural or mechanical means to and from any space. Such air may or may not be conditioned.

Ventilation rate: The rate at which outside air enters and leaves a building. Expressed in one of two ways: the number of changes of outside air per unit of time (air changes per hour, or ach) or the rate at which a volume of outside air enters per unit of time (cubic feet per minute, or cfm").

Wood preservatives: Includes creosote, pentachlorophenol, and copper chromated arsenate (CCA).

With permission, glossary terms and definitions were taken or adapted from the following sources:

(1) The American Lung Association, "Indoor Air Pollution Fact Sheets", 1986.

(2) The Baltimore Integrated Environmental Management Project (IEMP), "Indoor Air Pollution Issue Paper", February 1987.

(3) The U.S. Environmental Protection Agency, "The Inside Story, A Guide to Indoor Air Quality", September 1988.

(4) The U.S. Environmental Protection Agency, Indoor Air Facts Number 5, "Environmental Tobacco Smoke", June 1989.

(5) The U.S. Environmental Protection Agency, "Directory of State Indoor Air Contacts", September 1988.

(6) Honeywell Inc., "IAQD, Indoor Air Quality Diagnostics", 1988.

(7) National Safety Council, "Fundamentals of Industrial Hygiene", Third edition, 1988.

APPENDIX C
Indoor Air Quality Task Force Material
Special Collection : MDE Library
Bibliography No. 5
8 May 1990

Bardana, Emil J. and Montanaro, Anthony. "The Formaldehyde Fiasco: A Review of the Scientific Data." Immunology and Allergy Practice, 11 (January 1987): 11-24.

Brooks, James R. Radon and Your Home. Baltimore, Maryland: Department of Natural Resources - Maryland Geological Survey, March 1988.

Bruening, John C. "Seeking a Cure for Sick Building Syndrome." Occupational Hazards, May 1989.

California Air Resources Board: Public Meeting Agenda, 14 April 1989:
89-7-1: Report on Reducing Exposures to Indoor Air Pollutants in California: Existing Authorities and Recommended Actions.

89-7-2: Presentation on the feasibility of Economic Incentives as a Means to Reduce Emissions.

Sacramento, CA: California Air Resources Board, April 1989.

CanTox, Inc. Biological Risk Assessment of the Potential Carcinogens from Exposure to Airborne Formaldehyde, Version 2. Ontario, Canada: CanTox, Inc., 27 October 1988.

CanTox, Inc. The Effect of Tissue Damage on Cancer Production, Draft Report. Ontario, Canada: CanTox, Inc., 29 June 1988.

Center for Indoor Air Research (CIAR): Request for Applications, 1989-1990 Research Agenda. Linthicum, Maryland: CIAR, May 1989. Dr. Max Eisenberg, Executive Director.

Chemical Hypersensitivity Syndrome Study. Baltimore, Maryland: Rebecca Bascom, M.D., M.P.H., University of Maryland School of Medicine. Prepared at the Request of the State of Maryland Department of the Environment in Response to 1988 Maryland Senate Joint Resolution 32, March 1989.

Chemical Hypersensitivity Syndrome Study. Comments of the Review Committee. Baltimore, Maryland : Maryland Department of the Environment, Center for Environmental Health, March 1989.

Davidoff, Linda Lee. "Multiple Chemical Sensitivities (MCS)." The Amicus Journal (Winter 1989): 13-23.

Directory of Indoor Air Contacts. US/EPA/Office of Research and Development/Office of Air and Radiation. EPA/400/1-88/003, September 1988.

Drake, Anne (Honeywell, Inc.). "The Perfect Indoor Climate." Building Sciences, Vol. 14 (March 1990): 3-4.

Edmunds, Lavinia. "Sick Buildings." Johns Hopkins Magazine (June 1987): 22, 25.

Enders, Lawrence J. "Analyzing Formaldehyde's Effect on Reproduction" Contemporary OB-Gyn, February 1987.

Environmental Controls for Indoor Air Pollution: Proceedings of a Workshop Held in March 1988. Sponsored by American Thoracic Society, US/EPA, and others.

Environmental Engineering Selection Guide: 1989. A Directory to Board Certified Specialists in Consulting, Manufacturing, and Education, Volume 5. Annapolis, Maryland: American Academy of Environmental Engineers, 1989.

Environmental Illness: A Complex Multisystem Disorder. Annapolis, Maryland: The Environmental Illness Industry Committee (EIIC) for the 1988 Maryland General Assembly (SJR32). EIIC Position Paper, December 1988.

EPA Current Federal Indoor Air Quality Activities. Washington, D.C.: US/EPA/Office of Atmospheric and Indoor Air Programs, Office of Air and Radiation, August 1989.

EPA Indoor Air Quality Implementation Plan:
Appendix A: Preliminary Indoor Air Pollution Information Assessment.
Appendix B: FY 87 Indoor Air Research Program.
Appendix C: EPA Radon Program
Appendix D: Indoor Air Resource History
Appendix E: Indoor Air Reference Data Base

Washington, DC: US/EPA/Office of Health and Environmental Assessment, June 1987.

EPA Report to Congress on Indoor Air Quality. Washington, D.C.: US/EPA/Office of Research and Development, Office of Air and Radiation.

Executive Summary and Recommendations:
EPA/400/1-89/001 A
Draft: January 1989
Final Report: August 1989

Volume I: Federal Programs addressing Indoor Air Quality. EPA 400/1-89/001 B, August 1989.

Volume II: Assessment and Control of Indoor Air Pollution. EPA 400/1-89/001C, August 1989.

Volume III: Indoor Air Pollution Research Needs Statement. EPA 400/1-89/001D, August 1989.

EPA Survey of Indoor Air Quality Diagnostic and Mitigatian Firms. U.S. EPA, Indoor Air Division, Office of Air and Radiation (ANR - 445), November 1989.

Foliage for Clean Air: Working to Promote Indoor Plants for Cleaner Air. Falls Church, VA: Foliage for Clean Air Council, February 1989.

Formaldehyde Epidemiology, Revised edition. Washington, D.C.: The Formaldehyde Institute, Inc., October 1986.

Golos, Natalie. "Suggestions for a State Educational Program on Indoor Air Quality." Paper presented before the Governor's Indoor Air Quality Task Force Meeting held at Baltimore, Maryland, 16 December 1989.

Golos, Natalie and Golbitz, Frances Golos: Coping with your Allergies. Revised edition. New York: Simon and Schuster, Inc., 1986.

Health Benefits of Full Spectrum Fluorescents. Summaries from Professional Literature. Owings Mills, Maryland: Environmental Lighting Concepts (ELC), Hank Hyman, President, August 1989.

Hunter, Linda Mason. The Healthy Home: An Attic-To-Basement Guide to Toxin-Free Living, Pennsylvania: Rodale Press, 1989.

Imbus, Harold. Formaldehyde and the Immune System. Washington, D.C.: The Formaldehyde Institute, Inc., November 1988.

Indoor Air Facts. Washington, D.C.: US/EPA/Office of Research and Development, Office of Air and Radiation.

No. 1:	EPA and Indoor Air Quality	June 1987
No. 2:	EPA Indoor Air Quality Implementation Plan	June 1987
No. 3:	Ventilation and Air Quality In Offices	February 1988
No. 4:	Sick Buildings	July 1988
No. 5:	Environmental Tobacco Smoke	June 1989
No. 6:	Report to Congress on Indoor Air Quality	August 1989
No. 7:	Residential Air Cleaners	February 1990

Indoor Air Quality Management Program. Annapolis, Maryland: Anne Arundel County Public Schools, 29 March 1989.

Indoor Air Quality: Maryland Public Schools. Baltimore, Maryland: Maryland State Department of Education, November 1987.

Indoor Air Quality: Personal Exposure Assessment Five Year Study Plan. Sacramento, California: California State Air Resources Board. April 1989.

Indoor Air Quality Planning Strategy. Washington, D.C.: US/EPA/ Office of Research and Development, November 1984.

Indoor Air Quality Selected References. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, September 1989.

Indoor Air Quality Workshop Proceedings: 18 April 1985. Washington, D.C.: National Institute of Building Sciences, 1985.

Indoor Radon Pollution: Update. EPA Bibliographic Series. Washington, D.C.: US/EPA/Information Services and Library. EPA/IMSD/88-014, December 1988.

Inside Story: A Guide to Indoor Air Quality. US/EPA/Office of Air and Radiation. EPA/400/1-88/004, September 1988.

Interagency Committee on Indoor Air Quality. Comprehensive Indoor Air Quality Research Strategy. Washington, D.C.: U.S. Environmental Protection Agency, U.S. Department of Energy, U.S. Department of Health and Human Services, 1 January 1985.

Light, Edward R. "Misdiagnoses/Why Indoor Air Studies Fail: The Pitfalls and Fallacies." Indoor Pollution Air Report 3:3 (August 1989): 1-2.

Lippert, Joan. "Clearing the Air: Strategies for Beating Air Pollution-Indoors." Homeowner (October 1989): 28-32.

Lippy, Bruce. "Presentation to the Governor's Task Force on Indoor Air Quality: Lecture Outline." Submitted to members at Task Force Meeting held at Baltimore, Maryland, 16 November 1989.

Mangum, Gary L. Current Products Used in a Typical Contractor's Pesticide Spray Program. Burtonsville, MD: Creative Plantings, Inc., September 1989.

Maryland Occupational Safety and Health: Guides for Reviewing Indoor Air Quality. Baltimore: State of Maryland, Division of Labor and Industry, July 1989.

McGrath, Mike. "Potted Plants Pose no Mold Problem: and the RIGHT Ones Can Actually Clean Up Your Indoor Air." [Editorial Article] Rodale's Allergy Relief 3:12 (December 1988): 6-7. NOTE: This publication was discontinued in August 1989. Rodale Press cannot supply information on reference sources, states that readers must contact persons named in articles.

Morey, Philip R., Ph.D., and Shattuck, Douglas E., PE. "Role of Ventilation in the Causation of Building - Associated Illnesses." Occupational Medicine: State of the Art Reviews 4:4 (October-December 1989): 625-641.

Nero, Anthony V., Jr. "Controlling Indoor Air Pollution." Scientific American 258:5 (May 1988): 42-48.

Project Summaries: Indoor Air Quality in Public Buildings. Volumes I and II. US/EPA/Office of Research and Development, 1988.

Rafferty, Patrick J. "Cure for a Sick Building." The Weston Way 15:3 (Fall 1989): 8-13.

Residential Air-Cleaning Devices: A Summary of Available Information. US/EPA/Office of Air and Radiation. EPA 400/1-90-002, February 1990.

Schachter, E. Neil, et al. "A Study of Respiratory Effects from Exposure to 2 ppm Formaldehyde in Healthy Subjects." Archives of Environmental Health 41:4 (July/August 1986): 229-239.

Slutsker, Gary, editor. "Science and Technology: Paratoxicology." Forbes (8 January 1990): 302-303.

Spotts, Stevens, and McCoy, Inc. (SSM) Environmental Engineers. Marketing Literature Package. Towson, Maryland: John F. Hendrick, Manager - SSM Environmental Sciences, October 1989.

Standards, Regulations and Other Technical Criteria Related to Indoor Air Quality, Technical Report. Washington, D.C.: National Institute of Building Sciences for the U.S. Environmental Protection Agency, February 1986.

State of Maryland - Radon Task Force. Final Report to the Governor and the General Assembly. Baltimore, Maryland: Department of the Environment, The Governor's Radon Task Force. Richard J. Brisson, Chairman, February 1989.

Testimony before the Governor's Task Force on Indoor Air Quality. Public Hearing held in Annapolis, Maryland on 7 September 1989. Katherine P. Farrell, M.D., M.P.H., Task Force Chairperson.

Witness List

*Natalie Golos, Human Ecology Action

*Jeanette Gaydovchik and Evonne Day, Citizens with Asthmatic Children

*George Davis, Environmental Air Control, Inc.

*Robert Sheesley, Baltimore County Department of Environmental Protection and Resource Management

*Gary Mangum, Creative Plantings, Inc.

*Marcia Marks, Citizen with Asthmatic Children

*Luene Heffley, Citizen with Asthmatic Child
*Bruce Lippy, Aerosol Monitoring and Analysis, Inc.

*Linda Davidoff (indoor air quality recommendations)

*Bobbie Lively - Diebold and Steve Shapiro, Committee of Poisoned Employees (COPE): U.S. Environmental Protection Agency.

Minutes of Subsequent Meetings of Governor's Task Force on Indoor Air Quality, held in Baltimore at the Maryland Department of the Environment. Katherine P. Farrell, M.D., M.P.H., Task Force Chairperson:

- 11 May 1989
- 8 June 1989
- 13 July
- 21 September 1989
- 16 November 1989
- List of meeting held 5/11/89 thru 3/30/90

[*Transcript of Testimony is housed in MDE Library]

Testimony before the Subcommittee on Natural Resources, Agriculture Research and Environment, U.S. House of Representatives Committee on Science, Space, and Technology, Hearing on 20 July 1989 on H.R. 1530, "The Indoor Air Quality Act of 1989."

Witness List

The Honorable Joseph P. Kennedy (D-MA)

Panel I

*Ms. Bobbie Lively-Diebold, EPA Employee

*David Schlein, Co-Chairman, Safe Workplace Air Coalition, American Federation of Government Employees

Dr. William J. Rea, Physician & Robert Marvin, Jr., Patient

Panel II

*Dr. Thomas Burke, Deputy Commissioner of Health, State of New Jersey

Dr. John McCarthy, Environmental Health and Engineering, Inc.

Dr. Rebecca Bascom, Department of Medicine, University of Maryland at Baltimore.

Panel III

*Ms. Barbara Katz, Consumer Federation of America

*Dr. Ellen Silbergeld, Environmental Defense Fund

*Dr. Philip Bromberg, American Lung Association

[*Transcript of Testimony is housed in MDE Library]

The Total Exposure Assessment Methodology (TEAM) Study. Project Summary. US/EPA/Office of Research and Development, 1987.

Universities Associated for Research and Education in Pathology, Inc., "Epidemiology of Chronic Occupational Exposure to Formaldehyde: Report of the AdHoc Panel on Health Aspects of Formaldehyde." Toxicology and Industrial Health, 4:1 (1988): 77-90.

Van de Kamp, Jacqueline, MLS, compiler. "Indoor Air Pollution: Parts I-II," January 1984 through July 1988. NLM Current Bibliographies in Medicine, Nos. 88-10, 88-11. Bethesda, Maryland: National Library of Medicine, 1988.

Varma, Vish. "The Proposed Indoor Air Quality Act of 1989." The Weston Way 15:4 (Winter 1989): 16-20.

Wolverton, B.C., Ph.D., Harnessing Nature to Clean Polluted Water and Air. Submitted to National Aeronautics and Space Administration, National Space Technology Laboratories, Stennis Space Center, MS. April 1988.

Wolverton, B.C., Ph.D., Willard L. Douglas, Ph.D., and Keith Bounds, M.S. A Study of Interior Landscape Plants for Indoor Air Pollution Abatement: An Interim Report. Submitted to National Aeronautics and Space Administration, Stennis Space Center, MS. July 1989.

Wolverton, B.C., Ph.D., Anne Johnson, M.S., and Keith Bounds, M.S. Interior Landscape Plants for Indoor Air Pollution Abatement: Final Report. Submitted to National Aeronautics and Space Administration (NASA) Stennis Space Center, MS, September 1989.

Zielinski, Sally A. Indoor Air Pollution in Massachusetts: Interim Report. Boston: The Commonwealth of Massachusetts - Special Legislative Commission on Indoor Air Pollution, June 1988.

LEGISLATION

U.S. Congress, Senate, Committee on Environment and Public Works, Indoor Air Quality Act of 1988. S. Report No. 100-442, Calendar No. 857, 100th Congress, 2nd Session, 1988.

U.S. Congress, Senate, A Bill to Authorize the Indoor Air Quality Act of 1989. S. 657, 101st Congress, 1st Session, 1989.

U.S. Congress, House of Representatives. A Bill to authorize the Indoor Air Quality Act of 1989. H.R. 1530, 101st Congress, 1st Session, 1989.

VIDEOTAPES

Air Pollution in Your Home. One videotape (1/2 inch) 20 minutes. Wellesley Hills, MS: Professional Media Services, Inc. (PMSI), 1989.

Good Morning America - Sunday Today. [Indoor Plants and Indoor Air Pollution] one videotape (1/2 inch) 9 minutes and 20 seconds. Falls Church, VA: Associated Landscape Contractors of America (ALCA), November 1989.

No Place To Hide. One videotape (1/2 inch) 19 minutes. New York: American Lung Association (ALA), 1986.

APPENDIX D

List of Equipment Needed to Perform
Indoor Air Quality Surveys

ITEM	APPROXIMATE COST
Smoke Tubes	@ $60/box of 12
Velometer	$750 - 950
Balometer	$2,300
Detector Tube Pump	$150 - 300
Psychrometer	$150

The above information was supplied by the Maryland Department of Licensing and Regulation's Occupational Safety and Health Division.

APPENDIX E

ALTERNATIVE NON-HAZARDOUS PRODUCTS TO BE USED IN YOUR HOME

The following sources are the most frequent and most easily substituted alternatives. Since this list was compiled from a variety of sources, the Task Force can assume no responsibility for the effectiveness of these alternatives.

INSTEAD OF THIS:	YOU CAN USE THIS:
Ammonia-based cleaners	Vinegar, salt and water mixture for surface cleaning. Baking soda and water for the bathroom.
Abrasive cleaners	Rub area with one-half lemon dipped in borax; then rinse.
Floor or furniture polish	One part lemon juice, two parts olive or vegetable oil.
Toilet cleaners	Baking soda toilet brush.
Disinfectants	One-half cup borax in one gallon water.
Drain cleaners	Plunger; flush with boiling water, one-quarter cup baking soda, one-quarter cup vinegar.
Rug/upholstery cleaners	Dry cornstarch sprinkled on, then vacuum.
Water Softener	One-quarter cup vinegar in final rinse.
Stain Removers for:	
Oil	White chalk rubbed into stain before laundering.
Mildew	Lemon juice and salt or white vinegar and salt.
Heavy Soils	Rub with solution of two tablespoons sodium carbonate and one cup warm water.

Soiled Diapers	Presoak in three tablespoons baking soda dissolved in warm water.
Grease	Pour boiling water on stains and follow with dry baking soda. Or try ammonia and water.
Ink	Soak in milk or remove with hydrogen peroxide.
Blood	Soak in cold water or remove with hydrogen peroxide. For a more stubborn stain, mix cornstarch, talcum powder or cornmeal with water and apply the mixture. Allow to dry and brush away.
Coffee	Mix egg yolk with lukewarm water and rub on stain.
Chewing Gum	Rub with ice. Gum will flake off.
Lipstick	Rub with cold cream or shortening and wash with sodium carbonate.
Rust	Saturate with sour milk (or lemon juice) and rub with salt. Place in direct sunlight until dry, then wash.
Scorches	Boil scorched article in one cup soap and two quarts milk.
Glass cleaners	White vinegar and water or rubbing alcohol.
Metal Polishers for:	
Copper	Lemon juice and salt, or hot vinegar and salt.

Chrome	Rubbing alcohol or a small amount of ammonia with hot water. Also try white flour in a dry rag.
Brass	Equal parts of salt and flour, with a little vinegar.
Silver	Bring to boil in a large pan: One quart water, one tablespoon salt, one tablespoon baking soda. Drop in silver, boil for three minutes and polish with a soft cloth.
Stainless steel	Baking soda or mineral oil for shining, vinegar to remove spots.
Oven cleaner	One-quarter cup ammonia in a non-aluminum pan and add enough water to cover the bottom of the pan. Heat oven for 20 minutes, turn off and place pan in oven overnight. Baked on foods will be loosened, and the oven can be cleaned with baking soda and scrubbing.
Tub and tile	Use a firm bristled brush with either baking soda and hot water or the mild all-purpose cleaner consisting of one gallon hot water, one-quarter cup sudsy ammonia, one-quarter cup vinegar, and one tablespoon baking soda.
Furniture Polish	Dissolve one teaspoon lemon oil in pint mineral oil. Apply with rag.
Air freshners	Baking soda in your refrigerator or garbage can help reduce odors at their source. Grow house plants which are good sources for air purification.

NEVER MIX CHLORINE BLEACH WITH AMMONIA!

APPENDIX F

Design Standards

Introduction

The intent of this appendix is to provide substantive guidance to the facility owner planning a construction or renovation project. This section is organized into the 16 part Construction Specifiers Institute format to facilitate its use by design professionals. The primary goal is to eliminate to the greatest extent possible the sources of those contaminants which degrade indoor air quality. The secondary goal is control of the level of contamination by limiting or by diluting the contaminant. These standards were developed for use in schools that can easily be modified for other buildings.

DIVISION 1 - GENERAL CONDITIONS

1.1 Specifications

Project designer shall be required to certify that no hazardous material has been specified should substitutions occur, in the project. Provision should be in specs stating general contractor responsible for replacement cost and any resulting damages.

1.2 Testing

An independent laboratory shall be hired by the owner to determine that materials delivered to the project do not contain products expressly forbidden by the specifications. Initial tests will be paid by the owner. If a retest is necessary as a result of substitutions, costs of retest will be the responsibility of the general contractor.

1.3 Submittals

Certification of the composition MSDS information and a list of manufacturer, supplier, etc., will be required of the general contractor for all materials used. This should be a portion of submittals required for final payment.

1.4 Balancing

All air and water systems should be required to be balanced by an independent firm both at time of substantial completion and immediately prior to the end of the warranty period. This should include not only HVAC systems but also local and general exhaust systems.

1.5 Occupancy

Whenever possible occupancy should occur no sooner than two weeks after final installation of finish materials. During that period heating systems should run at capacity, in order to:

a. Test the system
b. Thoroughly dry the material
c. Accelerate any off-gassing.

Fresh air supply during this period should be 100% outdoor air.

1.6 Construction Sequence

General contractor should submit a ventilation plan prior to commencing work. Attention should be given to work on occupied facilities. This plan will demonstrate how the work site and the sources of contaminants will be isolated from occupied areas and avoid contaminants reaching the occupants by infiltration, contamination, or inversion.

1.7 Temporary HVAC

If building HVAC is operated during construction, it should operated with all return air shut off and 100% outside air used. Care must be taken that contaminants from construction activities do not enter the outside air intakes.

DIVISION 2 - SITEWORK

2.0 Selection

In selecting a site, care should be taken to identify potential hazards. Environmentally poor building sites can continually present negative influences on the indoor air quality of a building.

a. As a part of the new building planning, an environmental survey should be conducted to locate any hazardous waste and any underground tanks.

b. The vicinity should be surveyed for any neighboring sources of contamination.

c. The topography and micro climate should be assessed for conditions that may induce short circuiting of exhaust/intake systems.

2.1 Sensitizers

Identify potential sources of organic and inorganic sensitizers and locate fresh air intakes accordingly. The planting of trees and shrubbery in proximity to air intakes should be avoided to eliminate the intake of excessive allergens and to minimize the growth of mold and fungi in shaded, damp areas.

2.2 Layout

Air inlets and exhaust air outlets at the building exterior should be located to avoid contamination of the ventilation air supply. Contaminants from sources such as cooling towers, sanitary vents, vehicular exhaust from parking garages, loading docks, and street traffic should be avoided. Where soils contain high concentrations of radon, ventilation practices that place crawl spaces, basements, or underground ductwork under negative pressure could increase radon concentrations in buildings and should be avoided.

2.3 Outdoor Air

The outdoor air employed for ventilation and dilution of contaminants should not have contaminants exceeding concentration limits stated in the National Ambient Air Quality Standards (NAAQS) as established by the U.S. Environmental Protection Agency and enforced by the Maryland Department of the Environment.

If outdoor air gaseous and particulate contaminant concentrations are known to exceed the maximum levels established by the EPA NAAQS, the air should be treated by filtration and adsorption or other proven gas removal methods to reduce contaminants to acceptable levels.

2.4 Roadways

Buildings located near streets and highways may have elevated levels of lead and carbon monoxide in the indoor air. Road surfaces can also produce dirt and dust within a building. Factors that influence the potential impact of roadways include prevailing meteorological conditions and patterns of road usage.

2.5 Soil

Radon arises from the radioactive decay of certain elements in the soil. Radon levels in the indoor air depend upon the concentration of radon sources in the soil, the potential for migration into the building, and the specific location of concern within the structure. Below grade building levels are more susceptible to radon contamination. Unvented crawl spaces are also potential problems. There is a test to examine soil for radon; however, there is no agreement on how to interpret these tests and apply the findings to building siting or design. Because of this, <u>pretesting of sites for radon is not recommended.</u>

2.6 Foundation Drainage

DIVISION 3 - CONCRETE

3.0 Slabs on Grade

When a facility is designed as a slab on grade structure, care should be taken to seal all penetrations (plumbing, conduit, etc.) and construction joints. Vinyl gasket material and expansion joint filler should be available for use during concrete pouring. If sealing is necessary after the fact, a quality sealant rated for traffic resistance should be used. A facility with a tightly sealed concrete slab is less subject to concentrations of radon gas.

3.1 Sealers & Curing Agents

Many liquid sealers and curing agents release contaminants during the chemical curing process. Areas to be cured should be well-ventilated. Manufacturer's precautions should be followed. Occupancy should occur no sooner than two weeks following the application.

3.2 Additives

Lightweight concrete additives such as vermiculite or similar materials should be tested for asbestos prior to use.

3.3 Radon

The main pollutant of concern from the presence of concrete, is radon gas. However, truly hazardous radon emanation rates are rare. Studies and surveys of concrete used in various parts of the United States have shown that emanation rates from concrete samples are very small.

DIVISION 4 - MASONRY

4.0 Whenever possible cleaning of existing dirt and residue or construction residue should be done with high pressure water rather than acids.

If acids are used, provisions should be made so that vapors are properly vented and runoff neutralized prior to entry into the storm water or groundwater system.

4.1 Radon

The main pollutant of concern from the presence of brick or rock products is radon gas. However, truly hazardous radon emanation rates are rare.

DIVISION 5 - METALS

5.0 Primers

Primer coating on structural steel must be lead-free. This should be verified by an independent testing lab (DIVISION 1).

5.1 Thermal Expansion

Because structural steel is far more subject to differential movement as a result of temperature changes, care should be taken to isolate steel from masonry with materials that compensate for the movement (i.e. the seal between materials should not be compromised.)

DIVISION 6 - WOOD

6.0 Pressure-Treated Lumber

Pressure-treated lumber (both ground contact and fire resistant) should be sawn in an area that is properly ventilated. Care should be taken not to inhale or ingest the sawdust.

Pressured-treated lumber should not be burned.

6.1 Plywood and Casework

Hardwood plywood or products containing this material must be certified to be in compliance with the Hardwood Plywood Manufacturers Association Voluntary Standard for Low Emissions (HPMA FE-86) and the U.S. Department of Housing & Urban Development Standard 24 CFR part 3280.

icle Board and Casasework

icle board or prododucts containing this material must be ified to be in compimpliance with the National Particle Board ciation Voluntary y Standard for Formaldehyde Emissions -987) and in complpliance with U.S. Department of Housing Urban Development £ Standard (24 CFR Part 3280).

pre-drilled holes s in plastic laminate casework must be ged prior to delilivery to the job site. **ALL** edges of icle board are to b be covered with plastic laminate.

7 - THERMAL AND MOMOISTURE PROTECTION

ing Felts

roofing felts shou:ould be certified asbestos-free.

ing Cement

roofing cement shohould be certified asbestos-free.

Tar Pitch

coal tar pitch use(sed should be certified asbestos-free.

iculite

vermiculite shouldld be certified as asbestos-free.

isocyanurates and d Some Polystyrenes

isocyanurates and d some polystyrenes have been found to gas hazardous chchemicals when burned. Follow all facturer's recommemendations regarding proper installation hese insulting mataterials.

ants

e compounds are usased in a variety of applications. Caulks used around windowsws and doors to lower infiltration rates ugh building envelelopes. Caulks are also used in bathrooms nd showers, waterer fixtures, and tile to prevent water age. Sealants arere commonly used to waterproof surfaces roof joints. Adhesesives are used to install asphalt tile, ecure wall and floloor panels, and to fulfill a variety of ellaneous needs.

VOC emissions from sealants, adhesives, and caulks are difficult to characterize. A large number of different compounds have been found to be emitted from these materials. The composition and intensity of the emissions vary depending on the compound. In large part, these emissions depend on the type of solvent used in the specific formulation for each compound. Also, emission rates tend to be highest during the curing period. Studies to date indicate that it would be prudent to reduce the use of these materials to the extent possible and provide adequate ventilation when in use and while curing.

Vapor Barrier

For slab on grade concrete a vapor barrier of 6 mil polyethylene should be placed prior to concrete placement.

ISION 8 - DOORS AND WINDOWS

Natural Ventilation

Natural ventilation is defined as the movement of air into and out of a space through intentionally provided openings such as windows and doors, through non-powered ventilators, or by infiltration. Natural ventilation in Maryland schools is normally a supplementary rather than the primary means of ventilation. The ability to provide ventilation through operable windows is desirable for emergency use; for example, as heat relief in the absence of air conditioning or for purging smoke from a fire. If employed, natural ventilation should not prevent reasonable control of the thermal environment or otherwise impair the intended use of the space.

ISION 9 - FINISHES

Floor Coverings, Carpet, Vinyl Products

Adhesives used to apply flooring often contains VOCs capable of causing health problems. One contaminant emanating from carpet is formaldehyde used as glues in carpet backings. Vinyl products can off-gas plasticizers. Both of these emissions diminish dramatically over time. Wool fibers can cause allergic reactions in sensitized individuals. Vinyl asbestos tile remains in many school and office buildings. Acceptable work and disposal practices must be used when repairing removing, or otherwise disturbing this material.

A two week off-gassing period should be instituted between installation and occupancy.

9.1 Asbestos

The following materials should be certified asbestos free by independent tests:

A. Vinyl composition tile
B. Plaster
C. Gypsum Board joint compound
D. Stage curtains
E. Ceiling tile
F. Fritz tile
G. Perlite (spray texture)

9.2 Paints and Epoxy Coatings

Paints and epoxy coatings are highly variable mixtures of VOCs and it is difficult to predict emission rates. VOC release is short-term during the curing process with much lower levels over time. Paint should be applied and cured only in well ventilated conditions. Follow manufacturer's precautions.

9.3 Urea-Formaldehyde Foam Insulation (UFFI)

In the past UFFI was used as an insulation material because of its many desirable properties. The precise formulations used in these applications were usually proprietary, but essentially, UFFI consisted of the same glue used in various pressed wood products, a strong acid used to cure the glue, and a foaming chemical called a surfactant. These agents were mixed at the injection point and immediately introduced into the wall to be insulated.

Environmental factors and improper formulation can lead to significant emissions of formaldehyde from this type of foam insulation. High humidity increases the decomposition rate of the polymer, leading to formaldehyde release. Excess resin in the mixture will also evaporate over a period of time, since it is not chemically bound. In addition, temperatures above that of a normal room will significantly aggravate both of these conditions. UFFI has now been banned in Canada and parts of the United States. UFFI should not be specified.

9.4 Ceiling Tiles

All acoustical ceiling tiles should be certified asbestos free.

Some tiles have been identified as sources of VOCs and formaldehyde (binders). It is recommended VOCs (surface-coating) that these materials be installed prior to the pre-occupancy ventilation period.

9.5 Gypsum Board

Gypsum is a major component of wall-board (sheet rock). Although it has been theorized that gypsum made with phosphorus-containing material would produce significant amounts of radon, surveys have indicated that no significant increase in indoor levels of radon have been attributed to this source.

DIVISION 11 - EQUIPMENT

11. Ventilation

Special care should be taken to insure proper exhaust systems for dark rooms, kiln rooms, duplicating equipment, spray booths, woodworking dust-collection, and kitchen equipment. Proper operation of this equipment should be included in pre-occupancy balancing reports and also in the post-occupancy inspection during the guarantee period.

APPENDIX G

Excerpt from

INDOOR AIR QUALITY:

MARYLAND PUBLIC SCHOOLS

November, 1987

Building Maintenance and Operations

Once a building has been constructed, responsibility for preserving good indoor air quality rests with the building operations and maintenance functions. *School systems must establish a comprehensive facilities maintenance program.*

The office that supports this program should be involved before a new school or one that has undergone major renovation is accepted. This will enable its staff to understand the building systems as designed and installed.

Program Management

In order to implement a maintenance/operations program, three elements that must be provided:

1. *Administrative Support* from the highest level of the organization, including a firm commitment from the school board and/or supervisors must be solicited;
2. *Staffing* by trained, and competent personnel;
3. *Budgetary Allocations* to provide the operations and maintenance staff with the resources to provide the comprehensive services necessary to maintain indoor air quality.

The following areas need to be addressed and documented in a written program:

1. Inventory

A. What are the major building systems?

- i. Electrical
- ii. HVAC
- iii. Humidification
- iv. Incineration
- v. Plumbing
- vi. Special Areas:
  - Loading Docks
  - Food Services
  - Art Areas
  - Theatre Crafts
  - Automotive Repair Shops
  - Industrial/Vocational Shops
  - Duplicating and Copy Rooms
  - Teacher Lounges
  - Gymnasiums-Pools
  - Laboratories
  - Storage Facilities

2. Systems Description

A description of the systems, their specifications, control parameters, and design should be part of a Comprehensive Facilities Maintenance Plan. This is a particularly important and often overlooked program element. It is of crucial importance to both existingand new staff in the building.

3. Operational Plan

A written operations mnual should describe how to actually run the bilding systems. The plan should provide a deailed step by step procedure covering operation rom start up to shutdown. This document wil be an essential reference for day to day activiies and is a useful training document for new employees.

The written operationd plan should cover the building system instrumentation that will gather information or data on physical plant system performance. It should list cesign criteria; performance criteria; acceptable ranges for fluctuations in gauges, meters, and recorders; and trouble shooting strategies. Information on the frequency of both routine and preventive maintenance should be part of the document.

4. Comprehensive Preventive Maintenance Plan

A. The Concept

Preventive maintenance should be incorporated into any indoor air quality program. It is vital to periodically check systems to prevent small deficiencies from blossoming into major costly outages. For example, oiling a bearing on a fan system on a monthly basis will extend the useful lifetime of the unit and prevent the potential loss of make-up or exhaust air necessary for adequate indoor air quality.

B. Maintenance Scheduling

Scheduling periodic maintenance can be an important determinant of indoor air quality. Both the frequency and timing are important. For example, biological growth of fungi and bacterial organisms have often been isolated from a unit window ventilator with condensation pans. In some environmental studies, these organisms have been shown to cause disease in building occupants. Since school system unit ventilators run throughout the school year, they will accumulate an increasing bioload as the year progresses and will potentially be disseminating biologically active aerosols to the building's occupants. If the school system waits until June to clean and disinfect these units, they may pose a greater risk to building occupants than if they were to disinfect these units several times during the year.

Preventive maintenance must be tied to the buildings utilization schedule. For example, painting, coil cleaning or other projects involving the use of volatile organic chemicals should be scheduled to minimize the number of people potentially exposed. These activities are best done when there are few occupants and the facility has the opportunity to "air out."

5. A Materials Management Program

It is important to understand that the chemicals used in housekeeping, maintenance, operations, pest control, and cafeteria services can effect air quality and, subsequently, the health of a building's occupants. The chemicals used in the building should be inventoried and a material safety data sheet obtained from the manufacturers or distributors. *If the chemical composition is not specifically stated, the school has an obligation to reject the material and thereby not subject the building's population to unknown and potentially harmful effects.*

The chemical composition must be evaluated with regard to hazardous ingredients and also hazardous reaction potential based upon the use or application. Wherever possible, materials, chemicals, and reagents that present the lowest toxic potential should be used. By this, it is meant that if two floor strippers are evaluated, their solvent compositions should be compared on the basis of acute toxicity, concentration to be used in the task, and vapor pressure. Consideration must also be given to materials that present a risk of carcinogenicity, mutagenicity, or toxicity to a specific organ in the body.

Less toxic materials should be substituted for more toxic materials. In general, water soluble materials should be given preference to organic solvent systems. Materials that are higher in flash point and/or have a lower vapor pressure are also preferred. For example, latex, water-based paints are less noxious than oil-based paints. If oil based paints must be used, special low odor paints and/or ventilation practices can be employed. Sulfuric acid based drain cleaners have resulted in the emission of hydrogen sulfide gas in some institutions; sodium hydroxide drain cleaners might be preferable.

Minimize the quantities of potentially hazardous materials purchased, stored, and dispensed. One way of doing the latter is to evaluate the frequency of certain procedures. For example, one institution issued a contract to an outside firm to perform pest control in cafeteria and food storage areas. The outside firm was most anxious to appear conscientious and competent. In their zeal, they undertook a spray application program every five days. The compound selected for use had a 7.5 day half life (i.e., if one pound were distributed in the area, 7.5 days later half a pound would still be left on the surfaces). Within a short period of time there were no insects to be seen; nevertheless, the company continued to apply the insecticide, increasing the build-up of indoor environmental insecticide concentrations. In addition, stored concentrated stock solutions were found to be leaking and emanating vapors that were captured and circulated by the building HVAC system.

6. Roofs

Poorly drained roofs may be a potential source of poor indoor air quality. The architects designing facilities should take special care to ensure that roofs are sound and well sloped. Minimally sloped roofs invariably pool water and leak or require extensive maintenance involving adhesives or tars. These materials frequently enter the air intakes. The adhesives commonly used are potent central and peripheral nervous system toxins. The roofing tars are known to contain sensitizing agents, carcinogenic, and mutagenic polynuclear aromatic compounds.

These materials may be particularly harmful to children with growing bodies. Roofing operations, therefore, should be undertaken when the exposures to building occupants can be minimized. The best time is when the school is unoccupied. Wherever feasible, enclosed day tankers of tars should be used instead of open kettles to minimize the evolution of organic vapors. The tar tanks should be located as far from air intakes as possible and preferably downwind from the building. If such measures are not feasible, then certain air intakes should be temporarily blocked while provisions for supplemental uncontaminated outside air are made using portable fans.

Pooling on roofs resulting in stagnant, standing water can support the growth of algae, bacteria, and possibly viruses that can be drawn into building air systems. Leaks in roofs result in water damage or accumulation in ceiling tiles, rugs, or internal wall spaces. Fungi and bacteria that opportunistically capitalize on this moisture have been found to be responsible for allergies and respiratory disease. Consequently, when roofs are sloped inadequately or roof repairs are postponed, indoor air quality can easily be compromised. Water-damaged materials must be removed and replaced in a timely fashion before they serve as a substrate for biological growth.

In buildings that contain asbestos surface or acoustical treatments, water damage represents a particular health threat. Water can delaminate asbestos coatings, fireproofing, or decorative treatments. The weight of water-soaked asbestos may be sufficient to separate the coating from the substrate. Upon impact at the floor, free fibers of asbestos can be released into the room and distributed throughout the entire building.

In buildings where asbestos material has been encapsulated with a bridging agent, the weight of water from a leaking roof can bring portions of the encapsulated asbestos down. The resultant fiber release from the interior of the encapsulated material then creates a hazardous condition.

7. Condensation Pans

For years, chloroben (dichlorobenzene) has been in common usage as an algaecide in condensation pans. Normally it is mixed in a 1 to 4 ratio with water, and a cup is placed into the condensation pan on a monthly basis. One institution had to evacuate pregnant office staff with symptoms of nausea, headaches and malaise after a maintenance application of one gallon of pure cloroben into an operating air handling system. The organic compound volatilized and created airborne concentrations in excess of 200 parts per million (ppm). Chloroben has been associated with changes in bone marrow and blood cells. It often contains a manufacturing contaminant, benzene, that has been associated with leukemia. This substance is inappropriate in school settings. This unfortunate incident highlights the importance of understanding that "more is not necessarily better."

Condensation pans must be periodically cleaned and checked to ensure that they are draining. If an algaecidal treatment is not periodically administered, the drain lines can become blocked and must be reamed out. Non-draining condensation pans can provide an ideal dark moist environment for biological growth within air distribution systems.

8. Welding, Brazing, Cutting or Soldering

Maintenance operations, automotive repair, and theater or craft procedures involving welding, cutting, brazing, or soldering should be performed in ventilated facilities dedicated to those tasks. Often, however, these operations cannot be done in such a controlled setting and field operations must be undertaken. Welding, cutting, soldering, and brazing evolve toxic gases and particulates that should be vented outdoors. If this is not possible or impractical, then filtration is needed. To protect indoor air quality a portable system equipped with a high efficiency particulate filter backed with an activated carbon filter should be used. It is essential that such systems be equipped with a flexible capture hood to entrain environmental contaminants at their source.

9. Mechanical Systems

Pulleys, belts, bearings, dampers, heating and cooling coils, and other mechanical systems must be checked periodically. A checklist should be developed that is custom tailored for the particular building. This will assist the maintenance and operations staff when performing inspections. Pulleys and belts should be tightened as needed and changed prior to failure. Bearings should be lubricated or repacked to prevent major failure of vital system components. Air distribution dampers and baffles should be cleaned and cleared of debris periodically. Failure to perform these activities will result in an increase in resistance causing a decrease in air supply.

The air distribution duct network should have access ports to facilitate vacuuming deposited dust and particulate matter. It may be necessary at some point in the building's lifespan to use a dilute solution of bleach (sodium hypochlorite 5%) to decontaminate the inner surfaces of air ducts. This procedure is particularly useful if tobacco combustion products have condensed on the interior surfaces of the duct resulting in a "stale" air condition. This type of building maintenance task can not be performed if the duct has an internal fibrous noise insulating lining. Interior duct insulation should be avoided if at all possible. In addition, air filters must be changed periodically.

Building ventilation distribution networks are systems. The common practice of arbitrarily adjusting the dampers or baffles to accommodate complaints from one area should be avoided. By changing the air flow in one area, the system balance is shifted and distribution throughout the entire network will be effected. If there are complaints, it is recommended that the buildings air handling system be evaluated as a whole. Annual air balancing should be performed to confirm that the HVAC system and distribution network are adequate and meet design specifications.

In order for the building ventilation system to function properly, the control mechanisms must operate correctly. Gauges must be in calibration, sensors must engage at designated ranges, and transmission lines must not be defective. Pneumatic and hydraulic transmission lines should be checked for leaks. The control mechanisms should be included in the annual preventive maintenance program. They should be checked more frequently if the ventilation system does not perform as expected.

10. Vacuuming

Normal industrial vacuums emit particles and fibers in their exhaust. An improvement in performance can be obtained if they can be fitted with a high efficiency particulate airfilter (HEPA). HEPA vacuums should be selected in areas that might have spores or microorganisms. HEPA vacuum filtration ensures that potentially toxic or harmful aerosols are not dispersed while responding to a problem. HEPA vacuums are also recommended for use in automotive and industrial shops and in craft activities that generate dusts, fumes, or particulates. Dry sweeping in these areas should be curtailed.

11. Electrical Transformers

Electrical transformers that contain polychlorinated biphenyls (PCBs) must be checked monthly and inspected for leaks. The EPA has estimated that the risk of a transformer fire is on the order of 4-5/1000 units over a transformer's lifetime. The operations and maintenance program should contain a plan to either delist these units to PCB concentrations below 50 ppm or dispose of the liquid and metal carcass. The EPA has enacted regulations requiring network transformers to be decontaminated or scrapped by 1990. The EPA regulations require establishing an institution inventory of transformers and capacitors that contain more than 50 ppm of polychlorinated biphenyls. The transformers, capacitors, and transformer vaults must be labeled as specifically directed in the EPA regulations. Local fire departments must be supplied with a list of the location and description of the electrical components containing PCBs. A log book of monthly inspections of transformer vaults must be maintained as well as manifests documenting approved disposal.

Operations and maintenance procedures need to be drafted to maintain these units until the threat of a fire or PCB uncontrolled release can be eliminated. Ventilation to the transformer vaults may need to be modified to prevent toxic combustion products from being transported to the main areas of the building. Floor drains should be sealed in the vault areas and the areas posted in compliance with federal regulations. The operations and maintenance staff needs to have a working and written contingency plan for handling fires and spills of polychlorinated biphenyls.

The EPA regulations do not specifically require that PCB fluorescent light ballasts be handled as hazardous materials. Ballasts manufactured through 1978 may contain a small PCB capacitor. Ballast failure can volatilize both PCBs and the asphalt tar used to encapsulate the ballasts. Measurable quantities of PCBs have been documented by the EPA as long as a year post failure. Asphalt tars have been associated with symptoms of upper respiratory irritation. It is recommended that these type of ballasts be phased out as repairs and modifications are made in the buildings lighting system. Small quantities of ballasts can be disposed of as ordinary solid waste.

12. Drains

Drains in laboratories must be kept clear and in working order. Sediment in drain traps can provide an area where conditions support the growth and accumulation of biological organisms. In laboratory areas, broken mercury thermometers have often led to the pooling of metallic mercury in the sink traps. This phenomenon can chronically introduce mercury vapors into the indoor air. Acute exposures to plumbers and maintenance personnel must also be considered. Substitution of non mercury thermometers and gauges in laboratories is an easy preventive solution to this problem.

The antisiphon traps in sinks must contain water to prevent noxious odors from the sanitary sewer lines from migrating back into the indoor air spaces. Sinks and drains that are used infrequently can dry out allowing a path for gases to enter. Cupsinks in laboratory fume hoods and on benches frequently dry out and have often been found to be the sources of odors. This problem can be resolved and prevented by periodically running water in these drains, plugging unused drains with a rubber stopper, or using a non-toxic liquid with a low vapor pressure such as ethylene glycol to fill the antisyphon drain.

13. Building Use Changes

Special care must be exercised when building space utilization is changed. Renovation, redesign, or changes in building use can create situations that may lead to compromises in indoor air quality. For example, if a mimeograph or copy machine is brought into a small closet or other unventilated space chemical emissions such as mineral spirits or ozone may suddenly become problems. Impacts on heat load and noise levels must also be anticipated if new equipment is added to an already existing area.

A common renovation problem arises when additional personnel need to be accommodated in a space. Office or instructional areas are often partitioned and additional furniture and equipment installed. Anticipate the need to modifying the air distribution in these situations. Conversely, when partitions are removed creating new spaces, the ventilation distribution and balance must be revised. Care must be taken to ensure that, in the final design, air supplies are not located too near the exhausts so that short circuiting does not occur.

14. Pipe Leaks

Pipe leaks can occur through corrosion, mechanical failure, or because of the expansion of water due to freezing temperatures. In any case of leakage, repair or replacement of the damaged pipe section must be performed immediately. It is important that any and all leaked water be quickly removed and disposed of by pouring into a sanitary or storm drain. It is prudent to have available wet vacuums, submersible pumps, and squeeze brooms and mops to handle water emergencies. Water damaged ceiling tiles, rugs, insulation, or laggings must also be dried or removed and replaced in a timely fashion to prevent mold from growing. Following storms, it is good practice to inspect the building for discolored ceiling tiles or leaks as signs of water problems. Freezing can be prevented by ensuring that pipes that are potentially subjected to subfreezing temperatures are insulated or that the immediate spaces are connected to the heated interior of the building.

15. Filters

Mechanical equipment for ventilation, heating, and air conditioning contain filter media or screens to collect particulate matter from contaminating the coils, fans and interior housings, and duct work. Originally, the primary consideration was to protect the system from contamination and loss in efficiency resulting in equipment shutdown and extensive cleaning. Recognition is now given to the role filters can play in improving indoor air quality.

Filters are primarily classified into three (3) types: mechanical filtration, adsorption, and electrostatic. Corresponding examples of each are as follows: fiberglass filters seen in our home furnaces, self-contained filter fans seen in motel bathrooms that contain a charcoal filter, and large units usually placed on incinerators to remove charged particulate matter.

School systems are primarily concerned with mechanical filtration filters. Commonly used are the replaceable fiberglass filter media, the mechanical screen media that requires cleaning and recoating, and bag type filters on large air handling equipment. This filter equipment performs the function of coil protection, reduction of particulate matter to the air supplied to the occupied spaces, and reducing dirt contamination to ducts and accessory components. Filters are rated by efficiency, air flow resistance, and contaminant holding capacity. The method of entrapment is by impingement that locks the particulates within the filter. Filters have a life expectancy rated in hours when placed in use for a given air flow with expected contaminants. This life expectancy can be reduced by contaminants reaching the filter from events like severe dry spells blowing excessive dirt or interior dust producing activities.

Filters in air handling heating units should be changed based upon the pressure drop in the system and according to the manufacturers recommendations. In many cases, filters are not being changed this frequently. Consider what this means to the operation of the equipment and the occupants of the space:

1. Equipment efficiency is reduced and more energy is required to run the fan for pulling the air through the filter.

2. Some contaminants pass through an overloaded filter clogging the coils and entering the occupied spaces.

3. Over an extended period of time the dirt collection on the coils will diminish the thermal transfer efficiency of the unit resulting in higher energy consumption.

4. Contaminants on the coils can become a breeding ground for bacterial and fungus growth.

The above comments on air handling heating units are applicable to all types of equipment containing ventilation, heating, and/or air conditioning coil systems. One must consider the expense of extensive cleaning to return this equipment to proper operation as compared to the cost of replacing filters on a scheduled basis. All filters are not equal. In procuring replacement filter media, it is important to specify the proper filter media for the equipment that it will be installed on. Remember the characteristics of air filters: efficiency, air flow resistance, and contaminant holding capacity. Consider these characteristics in developing your specifications for filter media replacement and the development of your schedule for replacing filters in your equipment. The results of these considerations are a healthier environment, energy savings, and reduced costs for unscheduled cleaning of coil and duct systems.

APPENDIX H

DIRECTORY OF FEDERAL, STATE AND PRIVATE INDOOR AIR QUALITY CONTACTS

FEDERAL

Interagency Committee on Indoor Air Quality (CIAQ)

CO-CHAIR AGENCIES:

U.S. Environmental Protection Agency

Mr. David Dull
Acting Director, Office of Program Development
U.S. Environmental Protection Agency
401 M. Street SW (ANR-445)
Washington, D.C. 20460
(202) 382-7407

U.S. Consumer Product Safety Commission

Ms. Sandra Eberle
Program Manager, Chemical Hazards Program
U.S. Consumer Product Safety Commission
5401 Westbard Avenue, Room 419
Bethesda, Maryland 20207
(301) 492-6554

U.S. Department of Energy

Mr. John Milhone
Director, Office of Buildings and Community Systems
U.S. Department of Energy
CE-13, MS GH-068
1000 Independence Avenue, SW
Washington, D.C. 20585
(202) 586-1660

U.S. Department of Health and Human Services

Mr. Phillip J. Bierbaum
Director, Division of Physical Sciences and Engineering
National Institute for Occupational Safety and Health
U.S. Department of Health and Human Services
4676 Columbia Parkway (MS-R2)
Cincinnati, Ohio 45226
(513) 841-4321

MEMBER AGENCIES:

Bonneville Power Administration

Mr. John L. Elizalde
Chief, Residential Programs Branch
Bonneville Power Administration
P.O. box 3621-RMR
Portland, OR 97208-3621
(503) 230-7520

U.S. Department of Housing and Urban Development

Dr. Henry E. Felder
Deputy Assistant Secretary for Research
U.S. Department of Housing and Urban Development
Room 8154
Washington, DC 20410-6000
(202) 755-6230

General Services Administration

Mr. James I. Hensley
Chief, Environmental Management Division
Safety and Environmental Management Division
General Services Administration
18th & F Streets, NW
Washington, DC 20450
(202) 566-1464

National Bureau of Standards

Dr. James E. Hill
Chief, Building Environment Division
National Bureau of Standards
Building 226, Room B306
Gaithersburg, MD 20899
(301) 975-5851

National Aeronautics and Space Administration

Dr. Bill C. Wolverton
The John C. Stennis Space Center
National Aeronautics and Space
Administration
Building 2423
Stennis Space Center, MS 39529-6000
(601) 688-3155

Tennessee Valley Authority

Mr. Robert S. Rainey
Chief, Industrial Hygiene Branch
Tennessee Valley Authority
328 Multipurpose Building
Muscle Shoals, Alabama 35660
(615) 386-2314

U.S. Department of Defensee

Mr. E. Daniel Reinhard, Jr.
Director, Health, Safety & Environment
OASN (S&L)
U.S. Department of Defensee
Crystal Plaza 5
Washington, DC 20360
(202) 692-7076

U.S. Department of Justice

Ms. Amelia Salzman
Attorney, Land and Natural Resources Division
U.S. Department of Justice
10th & Constitution Avenue, NW Room 2133
Washington, DC 20530
(202) 633-1442

Occupational Safety and Health Administration

Mr. Ed Baier
Director, Directorate of Technical Support
Occupational Safety and Health Administration
U.S. Department of Labor
Room N-3651, 200 Constitution Avenue, NW
Washington, DC 20210
(202) 523-7031

U.S. Department of State

Mr. Steve Uman
Safety Director
U.S. Department of State
AVOPR/SAE
Room 2728
Washington, DC 20520
(202) 647-4302

U.S. Department of Transportation

Mr. Eugene L. Lehr
Chief, Environment Division
U.S. Department of Transportation
400 7th Street, SW Room 9217
Washington, DC 20590
(202) 366-4860

U.S. Small Business Administration

Mr. Kevin L. Bromberg
Assistant Chief Counsel
Energy and Environment
U.S. Small Business Administration
1725 "I" Street, NW Room 403
Washington, DC 20416
(202) 634-6115

U.S. Environmental Protection Agency

EPA Public Information Center: (202) 382-2080

National Pesticides Telecommunications Network Hotline:
(800) 858-PEST or (800) 858-7378 (toll free)
(806) 743-3091 (in Texas)

Toxic Substances and Control Act Assistance (TSCA)
Information Service: (202) 554-1404

Safe Drinking Water Hotline: (202) 382-5533

U.S. Consumer Product Safety Commission

Product Safety Hotline: (toll free) (800) 638-CPSC or (800) 638-2772

U.S. Department of Health and Human Services

NOISH Public Information: (800) 35-NIOSH or (800) 356-4674 (toll free)

Indoor Air Quality Assistance: (513) 841-4382

EPA REGIONAL INDOOR AIR QUALITY CONTACTS

EPA Headquarters
Indoor Air Staff
Office of Air and Radiation
401 M Street, SW
Washington, DC 20460
(202) 475-8470

EPA Region 1
JFK Federal Building
Boston, MA 02203-2211
(617) 565-3232

Connecticut, Massachusetts, Maine,
New Hampshire, Rhode Island, Vermont

EPA Region 2
25 Federal Plaza
New York, NY 10278
(212) 264-2517

New Jersey, New York, Puerto Rico,
Virgin Islands

EPA Region 3
841 Chestnut Street
Philadelphia, PA. 19107
(215) 597-9090
(215) 597-4084 (radon)

Delaware, Maryland, Pennsylvania,
Virginia, West Virginia, District of Columbia

EPA Region 4
345 Courtland Street NE
Atlanta, GA 30365
(404) 347-2864

Alabama, Florida, Georgia, Kentucky,
Mississippi, North Carolina,
South Carolina, Tennessee

EPA Region 5
230 South Dearborn Street
Chicago, Il 60604
(312) 886-6054

Illinois, Indiana, Michigan, Minnesota,
Ohio, Wisconsin

EPA Region 6
1445 Ross Avenue
Dallas, TX 75202-2733
(214) 655-7214

Arkansas, Louisiana, New Mexico,
Oklahoma, Texas

EPA Region 7
726 Minnesota Avenue
Kansas City, KS 66101
(913) 236-2893

Iowa, Kansas, Missouri, Nebraskas

EPA Region 8
One Denver Place
999 18th Street, Suite 1300
Denver, CO 80202-2413
(303) 293-1750

Colorado, Montana, North Dakota,
South Dakota, Utah, Wyoming

EPA Region 9
215 Fremont Street
San Francisco, CA 94105
(415) 974-8381

Arizona, California, Hawaii, Nevada,
American Samoa, Guam,
Trust Territories of the Pacific

EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101
(206) 442-4226

Alaska, Idaho, Oregon, Washington

Private Sector Contacts

American Institute of Architects
1350 New York Avenue NW
Washington, DC 20006

American Gas Association
1515 Wilson Boulevard
Arlington, VA 22209

Your local association or
American Lung Association
1740 Broadway
New York, NY 10019

American Society of Heating,
Refrigerating and Air
Conditioning Engineers
1791 Tullie Circle NE
Atlanta, GA 30329

Building Owners and
Managers Association
1250 I Street NW, Suite 200
Washington, DC 20005

Consumer Federation of America
1424 16th Street NW, Suite 604
Washington, DC 20036

Edison Electric Institute
1111 19th STreet NW
Washington, DC 20036

Safe Buildings Alliance
Metropolitan Square
655 15th Street, NW
Suite 12
Washington, DC 20005

National Association of Home Builders
Technology and Codes Department
15th and M Streets NW
Washington, DC 20005

World Health Organization
Publications Center
49 Sheridan Avenue
Albany, NY 12210

STATE OF MARYLAND CONTACTS

Maryland Department of the Environment
Air Management Administration
2500 Broening Highway
Baltimore, Maryland 21224
(301) 631-3200

Private homeowners

Maryland Department of the Environment
Toxics, Environmental Science and Health
2500 Broening Highway
Baltimore, Maryland 21224
(301) 631-3775

State and Local Goverments, Schools

Maryland State Department of Education
Schools Facilities Division
200 West Baltimore Street
Baltimore, Maryland 21201-2595
(301) 333-2534

Public School Systems

Maryland Department of Licensing & Regulation
Occupational Safety and Health
Consultation Services
501 St. Paul Street
Baltimore, Maryland 21202
(301) 333-4218

Private and Public Sector (Business & Industry)

APPENDIX I

Resolution #: 11-1859
Introduced January 30, 1990
Adopted February 13, 1990

COUNTY COUNCIL
FOR MONTGOMERY COUNTY, MARYLAND

By: County Executive and Council Members

Subject: Adoption of an Integrated Pest Management Policy for the Montgomery County Government

BACKGROUND:

1. From 1950 to 1983, U.S. pesticide production increased from 200,000 pounds to 2.7 billion pounds, a ten thousand fold increase.

2. Data from the United States Environmental Protection Agency, National Cancer Institute, and other agencies suggest that indiscriminate exposure to certain pesticides may lead to both acute and chronic public health problems.

3. The U.S. General accounting office report on the risks of non-agricultural pesticides (GAO/RCED - 86-97) finds that "there is considerable uncertainty about the potential for non-agricultural pesticides to cause chronic health effects such as cancer, birth defects and kidney damage."

4. Montgomery County has been a leader in the careful use of pesticides and notification of their application. Since 1985, the County Government has posted notification about its use of outdoor pesticides. The County Council passed a law (Chapter 38, Montgomery County Code) on April 1, 1986 which required posting of signs during and after commercial pesticide application and also required notification to customers about the pesticides used.

5. This law eventually led to similar State legislation. Annotated Code of Maryland, Agriculture Article, Section 2-103 and 5-108, which requires commercial pesticide applications to post signs during and after application, and provide information to customers about the chemicals used, their risks and precautions to minimize these risks.

6. The National Academy of Science in its 1980 report Urban Pest Management suggested that non-agricultural pesticide use could be minimized through development of Integrated Pest Management Programs, which are pest control programs using the least amount of chemicals possible to control monitored pest populations at acceptable levels.

7. Montgomery County's experience with Integrated Pest Management has been positive, with agencies as varied as the Montgomery County Public School System and the Maryland-National Capital Park and Planning Commission having successfully employed Integrated Pest Management, and with Montgomery Village having successfully employed such a program for landscape plants.

Resolution # 11-1859

8. Integrated Pest Management offers a safer and more effective alternative to a scheduled pesticide applications irrespective of infestation through a systematic procedure of monitoring for pests, record keeping, determination of pest population size and consequent selection of activities and controls.

9. A work group of county agency representatives whose agencies have responsibility for actual or contractual pesticide application and interested citizens was convened by the Department of Environmental Protection in 1987, and has met regularly since then to review several pest management issues.

10. This group has recommended that Montgomery County Government adopt an Integrated Pest Management program as its pesticide policy.

11. The Department of Environmental Protection sought comment on adoption of an integrated Pest Management at a session on June 9, 1989 for agency managers and decision makers, and sought final comment from agency directors in July, 1989 with no unfavorable responses.

Action

The County Council for Montgomery County approves the following resolution:

- Montgomery County Government will adopt an Integrated Pest Management program as its pesticide policy for its own employees and for contractors working in county buildings or on county-owned property.

- The County will continue to rely on its close association with University of Maryland's staff to provide training for its employees, as well as assistance in developing contracts for Integrated Pest Management vendors.

- The Department of Environmental Protection will administer these training programs and related Integrated Pest Management program administrative services through 1990.

- After 1990, a committee of agency-selected representatives will administer the Integrated Pest Management program.

- Agencies will be required to submit to this committee, on an annual basis, records of pesticide use for both the agency and its contractors.

- This policy becomes effective on February 13, 1990.

This is a correct copy of Council action.

Kathleen A. Freedman

Kathleen A. Freedman, CMC
Secretary of the Council

2302